THE
ELECTRICAL REVIEW.

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ELECTRICAL REVIEW

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THE NATIONAL FREE LABOUR CONGRESS.

THE sixteenth annual Congress of the National Free Labour Association will be held at the Memorial Hall, London, on October 26th, and following days. The Association, which does not perhaps come so prominently before the public as the more militant Trade Unions, has, in its unobtrusive way, done a good deal to help the large body of workmen who do not belong to any Trade Union. As is well known, Trade Unionists seek not only to limit their own numbers by attempting to restrict the number of apprentices, but they also claim a practical monopoly of the right to work at all. Whilst they complain of lack of employment, they deliberately prevent non-unionists from obtaining employment, by methods which are legalised under the misnomer of "peaceful persuasion."

It was to combat "Trade Unionist arrogance and tyranny" that the National Free Labour Association was formed. The Association came into prominence during the great engineering strike of 10 years ago, when a considerable number of its members filled the places of the Unionists; and history has repeated itself during the strike just terminated, and as a consequence the membership has considerably increased, the numbers now standing at 680,000.

At the forthcoming Congress one of the resolutions to be submitted demands the repeal of the Trades Disputes Act of 1906, under which Trade Unions are granted special class privileges, free workers being denied their "legitimate industrial rights to work free from the so-called peaceful persuasion of Trade Union pickets."

By another resolution the Association recognises the right of combination among all sections of the wage-earning classes, but commits itself to "unrelenting opposition to the insolent assumption of Trade Unionists of the right to deny to other men the right to work unmolested," and calls upon employers to "encourage those workmen who desire to gain an honest livelihood by diligence and industry without the dictation of Trade Union agitators."

The Association has no confidence in the Board of Trade's proposed permanent Arbitration Courts, seeing that the Labour Department of the Board is entirely composed of Trade Union officials, "whose reports are biased, one-sided, and absolutely unreliable as regards the general employment of labour in Great Britain and Ireland." It is pointed out also in the proposed resolution from which we are quoting, that past experience of B. of T. intervention in labour disputes has invariably been in the direction of forcing the recognition of Trade Union views and aims upon employers, so depriving the independent workmen of the employment which they have obtained during times of strikes.

The Congress will also consider a resolution opposing the statutory restriction of the hours of labour as is proposed,

for instance, in the Miners' Eight Hours' Bill. The Association stands, in short, for the freedom of contract between employer and employed, recognising the rights of the capitalist to safe and profitable investment of his capital, equally with the rights of the workman to remunerative and permanent employment. So long as the Association remains true to its fundamental principles as expressed in the series of resolutions to be submitted to the Congress, so long will it have the good wishes of all who believe in the principles of British liberty, which involves the right to work, free from molestation or interference on the part of those who have an equal right to strike work.

The Scientific Control of Fuel Combustion.

In presenting his paper on fuel combustion to the Iron and Steel Institute in September, we fear that Prof. Armstrong was appealing, we will not say to deaf ears, but to men with ears wilfully stopped. As a nation, we have been prodigal of our fuel. The best of it has gone already. There is little now left at shallow depths, except isolated pillars that will some day pay for removal, and that day will come only too soon if prices go up as fast as they have done this last twenty years. There is not the slightest present assurance that when our coal has gone there will be any substitute for it. In face of all this, how little do our big coal users care for economy.

Prof. Armstrong says that our coal in these islands cannot last many centuries. Nor will that of Germany or the United States at present rates, while China, if she wakes up, may almost as soon burn up her own huge stores. It sounds pessimistic, and it is just as well that the facts should be set down as the professor has set down some of them. But will the setting down appeal to his audience? Every pound of coal or coke burned in a blast furnace evolves an amount of combustible gas that will produce nearly as much power in gas engines as the original pound of coal would produce if burned under a steam boiler. The pig-iron is merely a by-product. Yet such of this gas as is utilised is burnt under boilers to produce steam power, at about a fifth the efficiency that it will give in gas engines. We build coal-burning power stations within a stone's cast of blast furnaces waving fiery flags of flame into the sky, and our engine shops complain of slackness of trade in face of the 30 firms building large gas engines in Germany for utilising blast-furnace gas on the lines laid down by an English inventor. Of all English blast-furnace men, how many had the intelligence to appreciate what blast-furnace gas would do? One can count them on the fingers of one hand.

Our iron-masters are not moving even yet, to any serious extent. There is the Cargo Fleet Co. with Belgian engines, and Sir Alfred Hickman with Belgian and English engines, but there is no such movement as there ought to be with the tremendous possibilities of electro-chemistry to swallow the whole of the power produced. It is a sorry spectacle, indeed, and one that every member of the Iron and Steel Institute should blush to see.

Prof. Armstrong's paper ought never to have been written. The mere fact that it has been written is a condemnation of the men, as a body, who sat to hear it.

But why should our iron-masters worry to save their gas money? As one of them said, "We can do very well without it."

Eyes have they, but they see not; Ears have they, but they hear not. Can it be that they have no understanding?

The Underground Breakdown.

The "hanging-up," on Saturday last, of the District and allied tube railways, which take a supply of power in bulk, as it were, from the Lot's Road power station, comes most unfortunately at a time when many engineers have satisfied themselves with several "last words" in power station design.

The Lot's Road plant has been regarded as one of these "last words," inasmuch as every effort was made by the designers to perfect an arrangement which would—short of complete destruction of the plant—continue its function of power supply. As many of our readers are doubtless aware, the steam and electrical plant is installed on the unit system, and the sub-stations are served by isolated duplicate feeders—cost having been subordinated to reliability of service throughout.

But as usual, the unexpected has happened. According to the meagre details contained in the official report, a surge of high-pressure current caused some control switches to fuse, and it became necessary to cut off the supply for repairs; this, in effect, meant the temporary shutting down of the District Railway, the Piccadilly and Brompton, the Baker Street and Waterloo, and the Charing Cross and Hampstead tube railways, and the Surrey section of the London United Tramways connecting Tooting, Wimbledon and Kingston, with its attendant dislocation of traffic, stationary trains in dark tunnels, stationary lifts in shafts, stationary tramway cars in public streets, &c.

Fortunately, no accident occurred, and fortunately also, the Chelsea staff rose to the occasion and succeeded, after some two hours' exertions, in carrying out such repairs as enabled the power supply and railway service to be resumed.

To us the serious point about the occurrence, lies not so much in the dislocation of traffic over the principal railway arteries of the metropolis, as in the suspension of power supply which led up to this.

The Lot's Road station has been regarded as a notable example of American engineering, and certainly many British engineers have not been slow to criticise its ultra-American features; moreover, uneasy rumours have, rightly or wrongly, been circulated in regard to it from time to time.

Now while American methods have not invariably proved the conspicuous success which certain admirers would have us to believe, and although we cannot recall a similar instance of breakdown of this magnitude in connection with a British-built railway power plant, we cannot say that failure in the direction indicated in the official report was ever considered as a likely source of trouble. Taking into account the magnitude of the problem which confronted the designers of the Chelsea plant, one must give them credit for a measure of success up to the present; indeed, time only can reveal the circumstances which may arise in connection with the operation of such a plant.

Meanwhile the question of power supply from independent sources will, no doubt, exercise the minds of many engineers, although with such an arrangement as that adopted at Chelsea, the provision of more than an independent emergency supply appears to us in the nature of a drastic remedy.

In fact, there appears to be no reason to suppose that the power-station authorities cannot provide against the recurrence of the trouble.

The matter, of course, reminds one of the various proposals to supply London with power from one large generating station which are before us at the present time, but the discussion of the question of the soundness of such a procedure is—taking into account the years which must inevitably elapse before the existing undertakers cease their supply, and the comparatively rapid advance in electrical knowledge—quite premature.

Tokio Exhibition Postponed.

We read in the *Chamber of Commerce Journal* that it is understood that the Tokio International Exhibition, which was to have been held in 1912, will be postponed for five years. It will be remembered that we have on several occasions referred to this exhibition as being

likely to afford an excellent opportunity for British manufacturers to demonstrate their ability to meet the needs of the Far Eastern markets. We are not aware what the reasons for the postponement may be. The year 1917 seems a long way off, and between now and then a quite extensive connection and business ought to be built up by any of our electrical manufacturers who have initiative enough to fully study the needs of that part of the world, and enterprise sufficient to meet those needs when they have diagnosed the case.

Scientific Method.

The paper read by the Brothers Cunliffe before the recent Congress of the Municipal Tramways Association is worthy of note in several respects. In the first place, it afforded a welcome variation from the usual programme, by introducing the technical aspects of tramway management from the engineering standpoint (it should not be forgotten, of course, that tramway management from the commercial standpoint is, strictly speaking, no less "technical.") Although there are numerous worthy exceptions, tramway managers, as a rule, are appointed for their administrative rather than their engineering qualifications, and the fact that several speakers in the discussion showed signs of resentment towards the presentation of the paper was evidence that they failed to appreciate it at its true value. One member thought that the paper should have been read at a "students'" meeting; who, then, are students? Lord Kelvin was a student to the last hour of his life; to decline the title implies either the possession of omniscience, or a preference for ignorance, and as the President wisely remarked, unless tramway managers continue to be students, they are not likely to retain their positions for long. Those of them who are entrusted with the whole responsibility not only for the operation, but also for the maintenance and renewal of their undertakings on the most economical lines, will do well to study such papers as this with diligence and thought.

In the second place, the paper bristled with original and novel ideas, some of them revolutionary in character and acute in formulation; and, lastly, it gave convincing proof, supported by the evidence of Mr. McElroy, the manager of the Manchester Corporation tramways—who is to be congratulated upon his noteworthy departure from the beaten track, in the appointment of these young engineers to investigate with open minds the whole question of tramway construction and operation—that the application of scientific method to the solution of the practical problems arising in tramway management is capable of producing economies enormously in excess of the cost of their purchase. That this was only to be expected does not detract from the value of the demonstration, which should be of the greatest benefit in inducing other authorities to proceed on similar lines. It is true that we British are apt to be what we call "practical" rather than "scientific"; not a few regard this as a wholesome tendency! But we are taking lessons from our German rivals, and a time may even come when we shall go one better; when, for instance, we shall require of a Prime Minister some knowledge of and training in the art of Government; when we shall appoint as Minister of Commerce (*vice* President of the Board of Trade) a man who has made a special and intelligent study of trade and industry; when our British Consuls shall be men of business and acumen; and so on. In the meantime, Manchester has led the way.

While not all of Messrs. Cunliffe's theories and suggestions may be acceptable to our readers (or ourselves), their paper is pregnant with matter for thought and investigation, and many of their propositions are supported by detailed evidence and logical arguments which leave no room for doubt as to their substantial truth. We only regret that the pressure on our space prevents us from reproducing in full the details and curves with which the paper is accompanied, and we recommend those of our readers who are interested in tramway matters to obtain complete copies of the paper.

Fire Risks at the Manchester Exhibition.

The electric light gives us the safest of all illuminants, and the use of electric power reduces danger to a minimum. Electricity displaces the open flame of gas, of oil, and the fire under the boiler, but there is still the risk, remote though it may be, of fire. The possibilities in this direction may not be easy to estimate, but it was certainly a fortunate thing for our profession that fire insurance offices appreciated the necessity of fire protection in the very early days of electric lighting, practically at the time of its introduction, for in this way have we learned what precautions are necessary to safeguard our private and public buildings. At one period the fire office inspector was looked upon as an obstructionist, just as were salutary Parliamentary restrictions, but when one remembers the kind of fittings and methods of installing the electric light in those early days, the wonder is not at the number of fires caused by the electric current, but at their very paucity. To-day the fire office expert is expected to know something of everything; he must be well acquainted with building construction, with fire producers and fire protection, and the hazards of all the various manufacturing and commercial occupancies of different buildings or factories, and the Manchester Electrical Exhibition is a case in point.

A wooden structure of a somewhat flimsy nature, with drapery extending from the roof along each side, no fireproof material in any part of the main building, or in its exhibitors' stalls, no supply of hydrants along the avenues, so far as we could see, and we have an ideal structure, to be reduced in an hour or two to a heap of ashes by the outbreak of an incipient fire.

Probably 50 per cent. of fires are due to faults of management, which include all sorts of readily avoidable conditions that are likely to cause or aggravate fire hazard; in other words, to "carelessness."

An American contemporary, commenting on a disastrous school fire in the United States, accompanied by great loss of life, remarks:—"The city authorities, the school authorities, all were negligent. Behind their negligence stands the great, gaping negligence of the public, the same negligence that causes annually in the United States more accidental deaths and injuries than three great wars."

Let it not be supposed that we are in any way alarmists, but may we hope that the city authorities of Cottonopolis and the Exhibition Committee have not been guilty of laxity, and that we shall have no cause for anxiety on the score of fire risks. The spasms of public horror are soon over and forgotten. They accomplish nothing.

The Press and the Exhibition.

It goes almost without saying, if such assurance were needed, that no great enterprise such as the remarkable Exhibition of Electrical Machinery and Appliances now open in Manchester could last for any length of time as a financial success without the cordial support of an appreciative public which will read, learn and inwardly digest, and accept without question what the Press, both technical and lay places before it.

Each morning the newspapers, and each week the electrical journals, should have no difficulty in finding something fresh to say on the wonders of the display, and in the Press the exhibitors have a medium for making known their business to a large section of the community such as no other means can convey.

The promoters and the committee of management must now be aware that the Press is with them all along the line, and we feel sure that nothing will be left undone by both sections of the "fourth estate" to ensure for the Exhibition the success which promoters, exhibitors, and the public desire.

D

IT PROVED A SLIP.

By J. HARDIE McLEAN, M.I.E.E.

Anyone who has heard the above expression would scarcely associate it with a hill slipping over itself.

When electrical engineers lay their mains to rest they seldom take into consideration the fact that one morning they may wake up to find that the roadway has dropped 8 or 10 ft. in places, and that the mains they have so reverently interred had anticipated the resurrection, and exposed themselves for a hundred feet or so—suspended across a chasm which did not exist the night before.

Such happenings are not to be sought for in far-off lands, but may be found within 120 miles of London. In the same district it is not unknown for folks, houses, horses and carts, &c., to disappear quite as suddenly as the hidden mysteries of modern science, in the shape of electricity supply mains, reappear in a state of suspended animation.

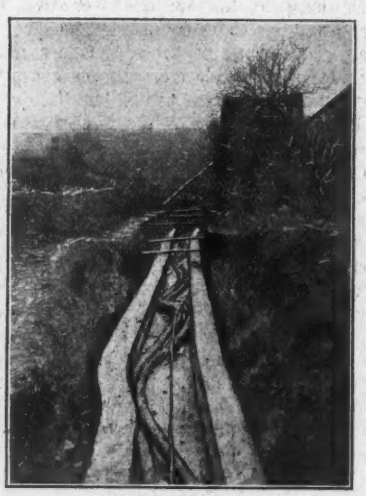
To allow for "slip" in certain engineering problems is a common and necessary factor, but where can the formula in regard to electrical supply mains be found? If it was reckoned in the manufacture of the main illustrated below, then the makers made a grievous error. The main in question is a ·105-7,000-volt two-phase cable manufactured by the British Insulated and Helsby Cables, Ltd., and laid by them for the Midland Electric Corporation for Power Distribution, Ltd., from its generating station—Ocker Hill—across country, being part of a ring main feeding Bilston sub-station, three miles distant. Mining operations in the South Staffordshire district, which forms the area of operations of the company named, are common, and subsidences are of frequent occurrence. In localities where they are anticipated, the mains are laid in a manner described later. In the case under consideration, the top crust of the hill seemed to move in a slanting direction, demolishing the houses in its path, and subjecting the mains to the "long pull." The result is seen in our view. It will be observed that the ends of the conductors are wide apart, in fact, 10 in., as shown by the rule included in the photo. The binding wires (No. 19 gauge) about the conductors gradually unwound as the joint parted, until they formed the only connection between the severed portions. A notable fact was that the lead sleeve only showed a gap of 3 in. This clearly proves that the lead covering stretched with the cable no less than 7 in., before evidence of what was going on inside could be detected by examination.

It was known for some time that the hill was on the move, and the ground at the joints was opened and all were examined on several occasions, but no appearance of damage could be seen. This is now easily explained. How long the supply had been passing through the single wires, it is impossible to say. The cable had supplied an important district in which nearly 2,000 H.P. in motors, tramways, and general lighting were connected. The fault was manifested by the binding wires acting as fuses on the breakdown of a motor on the "off side."

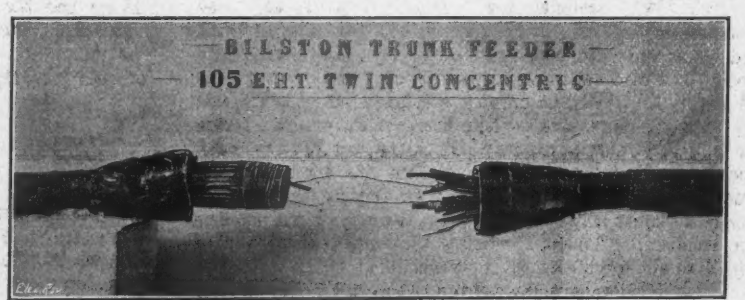
The other picture shows the mains being built into brick trenches with plenty of slack to protect them in further subsidences; also damage to house property adjoining the route of the mains. The road at the point in question had dropped about two yards in a single night, and exposed the mains, which had been laid solid in U-shaped earthenware troughs covered with bricks and filled in solid in the usual way. The method shown in the photograph was proved to be the best for dealing with moderate subsidences. Originally, in places where these manifestations were expected, the mains were drawn into iron pipes with brick pits placed at frequent intervals in which the cable was formed into a "bight," but in every case this proved ineffective because the bight bit, in other words, the main wedged itself in the brick pits.

In several districts the property owners—gas, electricity, water, &c., companies, have subscribed to purchase the mines beneath the roads and properties in order to protect them from utter desolation. A large portion of Brierley Hill and Quarry Bank were recently saved by this means. The Midland Electric Corporation subscribed liberally towards these purchases. In some instances whole streets have been ruined by the mining operations, the loss to owners of property being enormous, while the mining companies incurred no liability whatever.

Cottage Property Damaged by Subsidence.



Method of Slack Cable Laying, to Neutralize Road Subsidence.



View showing 7,000-volt Cable Severed by Earth Subsidence.

In active districts constant supervision is required, involving heavy expenses, in addition to the cost of following up the drop in gradual subsidences, and relaying mains in case of sudden and serious subsidences. These conditions apply also to railway, tramway, gas and water companies.

In one instance, where mains had to be laid across an active patch in cast-iron pipes with brick pits, as previously described, the original depth being 2 ft., when the cable broke down it was found to be 12 ft. deep—in other words, the road had been followed up no less than 10 ft.

Dover Electric Lighting.—The T.C. has resolved to expend £30 in advertising new economical electric lamps.

CONDENSERS.

It is argued by the *Engineer*, when commenting on Prof. Jones's paper on condensers, that the back pressure upon a low-pressure piston is often made high by the obstruction offered to the flow of steam into and among the tubes of a condenser, and it is suggested that instead of the usual method of admission at the mid-length of the condenser, the steam should enter it by way of a long slot extending the length of the tubes. This method has long been followed, and is carried out by Pollitt & Wigzell, the well-known Yorkshire engineers, by admitting steam at the end of the condenser to one side of the tube plate into a long triangular or tapering chamber, which tapers down to nothing at the other end of the condenser, and serves to distribute the steam over the whole length of the first bank of tubes. Wise designers also do not overcrowd the tubes, and will omit a number so as to form a V-shaped space in the very heart of the mass of tubes, thus providing a pair of long entrance walls in place of the one short wall represented by the distance across the top of the V.

It is common to refer to the great benefit which the steam turbine derives from a good vacuum and to deny to the piston engine any benefit from a vacuum above 26 in. This new gospel of vacuum has grown up since the introduction of high-speed engines, in which we may venture to suggest the low-pressure exhaust passages are insufficient in area to pass the steam sufficiently quickly to take advantage of the condenser pressure. Steam does not increase its velocity of flow necessarily because the external pressure into which it flows is reduced, for there is a certain limiting ratio of pressures beyond which no improvement is possible, and there must be an increase in the exhaust ports and passages. This fact is acknowledged in practice when two low-pressure cylinders are employed, though other considerations, as of weight, also enter into and influence design in this direction. But the turbine may be compared with a steam engine which sits directly on its condenser, without any reduced length of exhaust pipe as intermediary.

Now, it is not so many years since the vacuum sought for the large slowly rotating engines usual in the then biggest power stations was 28 in. This vacuum was obtained by the best engine men, and it was obtained with old plant and with cooling water by no means particularly cool. But care was given to packing of glands, to painting of all pipes in which the pressure was below atmospheric, and by such simple means as these there were obtained vacua of a degree now apparently only to be got by very much more complicated and expensive plant and by the use of vacuum augmentors or two-stage air pumps which, in too many cases, are only covering up bad attendance and careless workmanship. To-day condenser temperatures are worked which ought to go with 28 in. of vacuum.

While it is useless endeavouring to obtain a better vacuum than 24 or 26 in. of mercury column unless the steam can get out of the cylinder to give effect to that vacuum, it is also wrong when such a degree of vacuum is allowed to demand a disproportionately low condenser temperature. Were there no air in a condenser the vacuum would be represented by the absolute pressure corresponding to the condenser temperature. The presence of air raises the pressure according to Dalton's law of mixed vapours, but in the majority of modern condensing engines there is an unjustifiable amount of air present. This is the more marked when it is remembered how often the feed water has been boiled and purged of gases, and, therefore, the air which now vitiates a vacuum must have obtained entrance by illicit and preventable means. The engines which of old worked with so excellent a vacuum were not fitted with metallic packings. Metallic packings are the reply to high temperature steam. But is the low-pressure cylinder of a modern engine any hotter than in the low-pressure engines of 50 years ago? Surely not! And may it not be fairly stated as almost axiomatic that all glands below, say, 230° F. temperature should possess some old-fashioned fibrous packing for the sake of air-tightness? The efficiency of a tubular condenser is much reduced by air, for the air, not being a condensable gas, is left upon the tube surface when the steam is condensed, as pebbles are left on a sand riddle. That the speed of water flowing through a condenser tube has much to do with its condensing efficiency was demonstrated some years ago by, we believe, Prof. Osborne Reynolds, who found that the speed ought to be such as caused turbulence of flow. The Rowe tube and the use of spirals of thin sheet are merely methods of securing turbulent flow at any velocity. The efficiency of condensing surface appears then to be very much a question of heat transfer to the water rather than of heat passage from steam to tube surface, which is more or less complicated with the question of conductivity.

But it is obviously making a virtue of bad attendance to assert that the reciprocating engine does not profit by a good vacuum. It is convenient to advance crude statements about commercial economy to cover air leaks, but such economy does not fit well with the use of an excess of circulating water and an over-run air pump. If 24 in. is good enough, let the air pump be run at what should be a 24-in. speed, and let the boilers have the benefit of hot feed proportionate to the high absolute pressure of the condenser. Builders of reciprocating engines may, perhaps, in the future pay more attention to the exhaust passages of their low-pressure cylinders, in order to reduce the pressure nearer to condenser pressure. This would be a considerable assistance to the reciprocating engine in competing with the turbine. Incidentally, a full consideration of the subject seems to indicate the advantages of combining low-pressure turbines with high-pressure engines.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Tenders for Electric Lighting.

We have been very much interested in your article and the subsequent correspondence with reference to the recent tenders for the electric lighting work at Messrs. Selfridge's, and we had the curiosity to refer to the tenders for a previous large contract where the result was somewhat similar. The comparison is certainly instructive. Three firms quoted for both jobs, the figures being as under :—

	Contract No. 1.	*Contract No.* 2.
Firm A	£27,823	£9,157
Firm B	19,750	6,478
Firm C	16,865	8,074

It will be seen that Firms A and B agree almost exactly in pricing No. 2 Contract at 33 per cent. of their price for Contract No. 1. Firm C, however, prices it at 48 per cent. This enormous difference becomes pregnant with meaning when it is noticed that Firm C were the successful competitors in Contract No. 1.

Assuming that Firms A and B are correct in their estimate of the relative value of the two contracts (a fair assumption in view of their close agreement), it would appear that the experience gained by Firm C in carrying out Contract No. 1 has had a most salutary effect on their estimate for the later contract. The price of Contract No. 2, corresponding to 33 per cent. of C's price for No. 1, would be £5,570, which, it is interesting to note, would be the lowest but one on the list; the actual price quoted, however, is £8,074, representing an increase of no less than 45 per cent.

Does not this throw considerable light on the excessive differences which are unfortunately only too often found in contracts for electrical work?

One of the Tenderers.

Warning to Electrical Contractors.

Some little time back a man, ostensibly a farmer, and giving the name of Lawrence, of Leatherhead, called upon us with regard to an estimate for telephones in connection with his farm buildings, and wished us to make an appointment with regard to calling down there. Fortunately, we could not make an immediate appointment, and on writing

him at the address given, the letter was returned as "not known."

We understand he is about the neighbourhood again, and has got several electricians to go to that address on a Saturday afternoon; but, of course, the whereabouts of his farm could not be found, and it proved to be rather a useless hoax.

We wish to warn all our friends in the trade with regard to this individual.

Stegmann & Co.

London, S.W., *September 30th*, 1908.

The Woltereck Process.

I beg to thank you for your courtesy in publishing my letter in your issue of October 2nd.

Concerning the margin of profit, &c., I beg to state that I never mentioned either profits or margin in my paper, as stated in my letter to the editor of the *Engineer*, published in the issue of September 25th.

The reference to margin of profit was made by Prof. Turner, who appeared to have mistaken the results obtained from sugar carbon for those obtained with peat.

Herman Woltereck.

London, E.C., *October 5th*, 1908.

The Proposed Electrical League.

I should like to draw the attention of your contributor who writes under the *nom de plume* of "Manufacturer," to a letter I wrote you, which appeared in your "Correspondence" columns on page 367, September 4th, 1908, as that letter points out that the object of the suggested Electrical League is to consider the various reasons for the undeniable fact that the electrical industry is at present suffering from severe depression. Now, such an investigation is more likely to produce good results than any *laissez faire* methods. If, upon careful consideration, the conclusion is arrived at that nothing can be done to ameliorate present conditions, at least no harm is done; on the other hand, there is a possibility of a great amount of good being effected. So surely the attempt is worth while. At any rate, it seems likely that one result of the inquiry will be to bring forward an organisation that will be recognised as representative of the whole industry, co-operating with every existing institution, society, association, &c., and comprehending every interest, both on the commercial and on the technical sides, thus making it a power to be reckoned with, instead of a divided party with no policy in particular.

The very fact that so much correspondence has appeared in your columns on this matter indicates that there is a general feeling that something should be done, but, unfortunately, most of your correspondents expend the greater part of their space in criticisms of supposed methods, which only exist in their imaginations. It would be of great assistance to the industry at large if your readers individually would take the trouble to draft out and send you what they consider are the reasons for the present unsatisfactory position of affairs, without at the moment suggesting remedies or entering into historical matters. Then, when a general opinion has been arrived at as to what are the reasons, it will be easier to consider remedies.

R. Borlase Matthews, Wh. Ex., A.M.I.C.E.,
Hon. Sec. to Organising Committee.

London, S.W., *October 3rd.*

I have read the article by "Manufacturer" in your last issue. It contains several mis-statements, but I do not attach any importance to anonymous communications.

If "Manufacturer" will disclose his identity, I shall be prepared to show how his statements are inaccurate and unfair.

E. Garcke.

London, W.C., *October 3rd*, 1908.

Regenerative Electric Traction.

In view of your paragraph on page 558 *re* regenerative traction, we should be greatly obliged to you if you could find space in your next issue to point out that the J. L. Manufacturing Co., Ltd., which has recently been registered, and which has taken over the works of the Johnson-Lundell Electric Traction Co., Ltd., is in no way connected with them, and has not taken over any of their patents for regenerative traction.

We feel that without some statement to this effect the paragraph in question might be detrimental to this company.

The J. L. Manufacturing Co., Ltd.
H. Rottenburg, *Director.*

Southall, *Oct. 5th*, 1908.

MUNICIPAL TRAMWAYS ASSOCIATION.

The Application of Technical Science to the Construction, Maintenance and Operation of Tramways.

By R. G. Cunliffe, M.Sc. Tech., and J. G. Cunliffe, M.Sc. Tech.
(Assistant Electrical Engineers, Manchester Corporation Tramways).

In constructing a tramway the following principles should be kept constantly to the front, as the original design determines very largely the subsequent cost of maintenance and working:—

The most economical position for a generating or sub-station, or a line feed point, is at the centre of gravity of the electrical loads; thus for uniform traffic conditions and level lines the best position for the feed points is at the centre of the sections. Feeding from both ends of the sections is exactly the same as feeding from the centres, and, at the same time, running the feeders in parallel; as it is preferable to work the feeders independently, the most economical way is to feed from the centres.

For mechanical requirements a small trolley wire only, say 00 s.w.g., is required. This is quite strong enough, and has better wearing properties than a larger wire, as the hardness lies in the skin, which is of approximately the same thickness for all sizes of wire. In Manchester, however, a 000 s.w.g. conductor was employed until recently, and now a 00000 wire is generally installed. This has been strongly criticised from time to time, and Mr. R. N. Tweedy holds that the most economical section of trolley wire is the smallest which it is possible to use with safety both with regard to mechanical strength and current density.*

A trolley wire is very similar to an overhead transmission line, and no consulting engineer would attempt to install one of these without first calculating the most economical size of wire to employ. The problem is not very difficult in the case of a transmission line, but for tramway work the wire is constantly wearing, and the difficulty is to determine the depreciation. In addition, maintenance and renewal charges now appear.

From a knowledge of the capital costs of material and labour in erection and removal, the interest, depreciation and scrap values, the most economical life and then the most economical size of wire are determined.

Mr. Tweedy further objects to the short life usually allowed of about seven years. We, in Manchester, find it most economical to allow three to five years, according to traffic density. These figures may appear surprising, but this is only because the value of the electrical losses is seldom realised.

The calculations have been carried out for city, urban and suburban lines, with the result that the wire should vary in size from 6/0 to 5/0 to 4/0 respectively; but as, in the city, the feeding points are, as a rule, very close together, the difference between the 5/0 and 6/0 wires is only apparent on about two short sections; and so for the suburban lines 4/0 wire is employed, and everywhere else a 5/0 wire is installed. It is found that the same line fittings can be employed for both 4/0 and 5/0 s.w.g. wire, but not for 6/0 wire. The saving varies according to the length of the section and the traffic density, from £1 to £10 per mile of wire per annum, and as Manchester has over 200 miles of overhead line, the matter becomes of importance. In addition, maintenance and emergency costs are diminished because the wire is never allowed to wear thin. An interesting side issue is that the anchoring of worn lines is a waste of money, as when a line is ready for anchoring it is ready for renewing.

In Manchester the insulation is triple, the component parts being as follows:—Primary—Insulator bolts in hangers; Secondary—Globe strain insulators; Tertiary—Brooklyn strains. Of these the primary is the weakest and least necessary.

Messrs. Tweedy and Dudgeon have shown before the Institution of Electrical Engineers that the failure of the primary insulation is due to electrolysis, but they have not explained how this is caused. Experiments carried out in the test room at Manchester show that, under the influence of capillary attraction and of electrical

* Electrical Review, Vol. 62, page 886.

endosmose, more especially of the latter, water saturated with atmospheric impurities, which in Manchester is a powerful electrolyte, is drawn between the metal bolt and the insulating material, and is forced across from the positive metal of the bolt to the negative metal of the hanger. Electrolysis takes place; the metal of the bolt is corroded; a rust film is formed beneath the insulation which is split asunder. The experiments fully bear out the above theory of the cause of failure.

In practice there is a considerable benefit to be derived from having the trolley wires working in parallel, but it is of very little use to have them paralleled at two or three points only by means of "jumpers." They should be paralleled at every span by removing the insulator bolts and building the line as described in the final section of the paper, either with or without the central conductor. The saving effected would be considerable under practical conditions.

It has been the practice in Manchester, and is still the practice on most other tramways, to use a combination of 3¼ in. and 8½ in. bonds, mostly 0000 S.W.G. In Manchester, two of the former and one of the latter have been used at every joint.

That under ordinary circumstances there is no excuse whatever for the existence of any bond over 8½ in. in length is shown by the following figures, viz.:—

Resistance of 30 in. of 100-lb. rail, fish-plated and bonded with two 34-in. Chicago and one 8½-in. Crown bonds, all of 0000 S.W.G. = 0·000021 ohm at 60° F.

Resistance of 30 in. of 100 lb. rail, fish-plated and bonded with two 8½-in. Crown bonds = 0·00002108 ohm.

The difference is hardly appreciable, yet the saving per joint amounts to the value of one 34-in. bond, and the difference in cost between a 34-in. and an 8½ in. bond. Either joint is as good electrically as the solid rail.

As a general principle it is uneconomical to run copper conductors in parallel with heavy steel rails, as the rails themselves have a better conductivity than any copper of an economical section. Thus, in the case of junctions, cross-over roads, &c., it is far better to efficiently bond the component parts together by means of short bonds than to run long copper strips haphazard round the special work. Every inch of copper other than the nead in a bond is worse than waste, as it causes loss.

A factor which is far more important than rail drop is length of section, as the leakage currents are proportional roughly to the cube of this length. Thus return feeders should be installed at short intervals, and it is better for each positive feeder to have its negative, as in Manchester. Negative feeders are useless unless they draw the current from the rails in both directions. If a feeder alone will not cause this reversal, then a negative booster should be employed.

During starting, a certain tractive effort is required in order to produce the requisite acceleration. As the speed increases, the voltage required to send the requisite current through the motors must be increased, but, at the end of the series operation, the maximum voltage that can be provided is some 250 volts per motor, so that there is a limit to the speed that can be attained in series. This limit, however, is never reached.

The maximum demand of the car occurs during parallel running, as, the tractive effort remaining about constant, the rate of supply of energy to the car must increase with the speed. In practice this is shown by the doubling of the current in parallel.

It is important that this maximum demand should be kept low, and this can only be done by diminishing the tractive effort required—*i.e.*, the acceleration, during parallel working, and since a definite average value of the acceleration is required throughout the starting, the acceleration must be increased in the series control, without diminishing in the least the time occupied in passing through the series notches, since this time is just as valuable as the acceleration itself in producing speed. The only way in which the result can be obtained is by diminishing the resistance on the various series notches, and in Manchester we have so treated a G.E. 52 equipment, reducing the resistance on the second series notch, and cutting it out altogether on the third, so that during the whole time allowed for the third and fourth notches the motors are running on the line. An appreciable increase in series acceleration was obtained, and the maximum demand was reduced by 12 per cent.

It is of great importance that the gearing should be kept in good condition, and the driving axles perfectly straight, as we found that a bend of from $\frac{1}{16}$ in. to $\frac{1}{8}$ in. in the centre would cause a loss of efficiency of from 8 to 16 per cent.

It is of advantage to obtain as high an average speed as possible for the system, as thereby not only is the number of cars necessary for a given service diminished, but although the working current is slightly increased, yet the units per car-mile are lower, as the increase in current is not in proportion to the increase in speed.

During the past working year the account for energy supplied to the Manchester tramways amounted roughly to £143,000, so that every 1 per cent. saved represents over £1,400. By adopting the larger trolley wire Manchester saved several thousands of pounds per annum, in addition to paying the difference in capital costs, &c., and such saving will continue indefinitely.

Another large saving is effected by properly maintaining the gearing and axles of the cars. If the gearing is kept in the best possible condition the loss will be £7,000 per annum, but if neglected it can rise to £35,000 per annum. Bent axles may safely be said to account for another £5,000 per annum, and with the slightest neglect this can become £10,000.

The efficient maintenance of these parts of the equipment is a costly process, but the care and expenditure are repaid by a saving of many thousands per annum, and the economies effected must, on the whole, make themselves felt even in Manchester's annual expenditure of £500,000 in working costs.

Suggestions for Profitable Research.—Silicium bronze wire possesses far better wearing properties than a large copper wire, as it is harder, and in addition its hardness extends throughout; as the conductivity of silicium bronze is only 60 per cent. of that of copper, however, it becomes in the end an extremely costly metal to employ, and the 00 S.W.G. silicium bronze trolley wire at present being installed by certain English tramway authorities must be very uneconomical indeed.

In order to combine the mechanical properties of silicium bronze with the electrical properties of copper, we suggest an equipment consisting of two trolley wires of small gauge silicium bronze to take the wear, and a central conductor of copper to carry the current. The three would be connected together at every span, the centres of the spans being made of silicium bronze stranded wire in order to carry the current. The present primary insulation would be abolished together with the costly hangers, a simple gun-metal attachment being required.

The first cost would be heavy, but the life of the line would be much greater, and when the time for renewal arrived, only the small silicium bronze wires would require replacing.

Experiments show that the fishplates provide an important part of the conductivity of the rail joints, being on the average better than a 0000 S.W.G. 34-in. Chicago bond. As the mass of metal is nearly equivalent to 1 sq. in. of copper, we suggest fishplates with a thin layer of soft copper electrolytically deposited on their edges, tightly screwed to rails having their flanges cleaned and painted with copper sulphate solution. A copper to copper contact would be obtained, and it might be found possible on experiment to dispense with bonding altogether.

As both maximum demand and current consumption are proportional to weight of car, this should be kept as low as possible, and any additional expenditure in providing cars of pressed steel with girder sides entirely self-supporting would be repaid by the saving effected.

The most important factor in the current consumption is the driving, and by taking from the driver the control of rate of acceleration whilst leaving him full control of the starting and stopping of the car, much could be saved without risk of damage.

Motors should be designed for the highest possible torque per ampere, and the starting qualities should be watched just as zealously as the load efficiency at 500 volts.

By the insertion of thin sheets of hard steel between the poles and the yokes, a sufficiently high permanent magnetic field to permit of reliable rheostatic braking might be obtained without appreciable loss of efficiency, and the bonding together of the two motor frames makes this independent of the track.

The gear ratio should be as high as is obtainable with single reduction gearing, and the Renolds silent chain might here be worthy of consideration.

The pinions would probably be better made like a truncated cone, with the smaller diameter towards the motor, as pinions worn to this shape give a higher efficiency than when parallel, since, with parallel pinions, the inner ends of the teeth dig into the metal of the gear wheels, owing to whipping of the armature shaft.

Discussion.

Mr. H. G. Yerbury (Sheffield) congratulated the authors on bringing forward a paper of such an interesting nature, and quite agreed with their general conclusions with respect to overhead line equipment in Manchester, where current was purchased at a rate approximately double what theirs cost in Sheffield; but he could not agree that a trolley wire was very similar to an overhead transmission line, for that was invariably used in connection with high-tension work, where the conditions were altogether different. It was regrettable that the authors made no mention as to the size and losses on their feeders, which, presumably, were paid for by the tramways department. He was surprised to observe that the authors recommended that wires should vary from 000000 to 0000; he preferred a system of underground feeders varying in size, and to maintain a uniform size of trolley wire. With respect to insulation, by adopting galvanised or sherardised bolts in Sheffield, the life had been increased at least fourfold. Rust was the cause of all the trouble, not electrolysis. If drivers could be educated to work controllers and brakes in an efficient manner, the result would be a saving at least equal to that obtained by regenerative control. Having had eight or nine years' experience with bronze wire in actual use, he knew that, with a two-minute service of cars, a bronze wire would carry just as much current and was safer four years after erection than a copper trolley wire erected at the same time. With bronze wire they had practically no wear after four years, whereas with copper, by the author's own showing, they had as much as 40 per cent. wear and 44 per cent. increase of resistance. The original No. 0 trolley wire, which was erected in Sheffield in 1897, was in service at that moment.

Mr. C. J. Spencer (Bradford), referring to the statement that as a general principle it was uneconomical to run copper conductors in parallel with heavy steel rails, urged that in some cases it was necessary to increase the current-carrying capacity of the return circuit on account of the heavy density of the current, exceeding the nine amperes per square inch allowed by the Board of Trade, and that in those cases the handiest method was to lay parallel with those rails a bare copper cable. It was acknowledged that deterioration of equipment had a good deal to do with the great increase in current consumption; he had pointed that out some years ago, and their investigations in Bradford had fully confirmed that view. He would suggest also that defective field coils, of which the insulation had given way, had a good deal to do with the increase, and that the deterioration of the insulation between the plates of the

armature cores, was the cause of one of the serious leakages in the machines. It did not pay to wear the gears out to the last razorlike edge; not only economy of current consumption, but also the convenience of passengers had to be considered. He agreed that the most important factor in current consumption was the driving, but thought that taking from the driver the control of the rate of acceleration whilst leaving him full control of the starting and stopping of the car would not work out in practice. It was necessary to vary the rate of acceleration of a car according to the conditions of traffic round it, and the driver should be left with some discretion on that point. But the driver was the great current waster. Some method of check on each man was necessary, and in Bradford they had adopted the system of fitting each car with a meter, and found that that gave them very excellent results. He had had some experience with chain-gear upon motor vehicles, and strongly objected to its use on cars. The queer wear in the pinions was not, in his opinion, due to the whipping of the armature shaft causing the teeth to dig into the metal of the gear wheels, as most armature shafts were amply big enough for their work; he thought the motor suspension bearings were allowed to wear away rather more than was advisable before being changed, and this interfered very materially with the alignment between the gears, with the inevitable consequence that the teeth of the pinion, instead of being worn parallel, were worn in this wedge fashion.

Mr. Henry Mozley (Burnley) said they had experimented with time-meters on four-motor equipments. The result was that since December last year there had been a saving of no less than 14 per cent. of energy simply by being able to tell each driver at the end of each month how many minutes he had had the controller in operation. They were now going to apply the same system to every car in the service.

Mr. J. M. McElroy (Manchester) said the paper had several points which were very valuable to practical men. Their problem in Manchester was the maintenance of the tramways. They were paying to the electricity department 1·14d. per unit. If they let their rolling stock go down, their trolley wire or equipments wear badly, they were paying for it in current; the authors had been endeavouring to find out where was the point of maximum economy, and their work had been of very great assistance to him. They were now taking out all their field coils, and renewing all their gears. The efficiency of new gear wheels was practically 95 per cent., but with very worn gears it was a little over 75 per cent., so there was a big break in efficiency, which they were paying for in current. This method of investigation was of advantage in other parts of their equipment, and was very practical and very useful, and no doubt had tended to decrease some of the expenses of maintenance connected with the Manchester Corporation tramways.

Mr. Howley did not agree with the authors in regard to the use of excessively heavy trolley wires; nor with Mr. Tweedy, that No. 0 wire was of sufficient section for any line. He had a very strong suspicion that the wire they were getting nowadays was not of the same quality as the wire which was obtained 10 or 15 years ago. He had experimented in different places with both watt-meters and time-meters. Watt-meters were somewhat costly, and required a good deal of maintenance; they would often vary as much as 20 per cent. Time-meters tended to reduce the current consumption per car-mile, but after they had been fitted for some time, he found it most difficult to make motormen keep time. Personally he would not adopt either hour-meters or watt-meters; they were using ampere-meters, which were a different thing altogether.

The President (Mr. J. Aldworth) said he very much regretted the remarks which fell from one member in saying that this was a paper which, perhaps, might be better read at a students' meeting. There were no more diligent students than tramway managers and tramway engineers. There was no such thing as finality in the working and equipment of tramways, and unless they watched the thing and studied it as they went along they were not very long going to hold their positions. He thought they could not do better than give the authors a most hearty vote of thanks for the trouble they had taken.

Mr. R. G. Cunliffe, in reply, pointed out that the only factors influencing the electrical loss were current carried and electrical resistance of line, and as the average trolley wire carried more current than a transmission line transmitting many thousands of horse-power, they held that, although the distances were not so great, the trolley wire was to all intents and purposes a transmission line. The size of the feeders did not influence in the least the size of the trolley wire. The only important factor was the number of feeders, as this determined the length of the section, and hence the current carried by the trolley wire. As for the Manchester feeders being cut fine, Manchester had some 20 sub-stations in addition to its large low-tension traction generating station; the line feeders were short, and in no case less than 0·5 sq. in. in area, the majority being 1 sq. in. and many being 2 sq. in. Few tramway systems were so efficiently served. It was now generally admitted that rust was only the physical evidence of electrolytic corrosion. A No. 0 s.w.g. silicium-bronze wire could carry the current necessary for a quarter-minute service, but for Manchester its adoption would mean a loss of £2,000 per annum in current charges alone. It was better to place the negative feed points closer together than to run copper cables in parallel with the rail, as, double track being equivalent to 4 sq. in. of copper, it would require a huge cable to take any large percentage of the return current. The limiting series speed was never reached, because the time required would be some 500 seconds after the motors were switched in series on the line, whereas the time allowed in practice between the last series notch and the first parallel one was only some 2 seconds. There was no difficulty in applying short bonds to hard manganese steel special track-work, as pieces of soft steel could be cast in and afterwards drilled for the reception of the bonds. The field coils must be kept in good condition at any cost, as internal short-circuits, by diminishing the strength of the magnetic field, reduced the torque per ampere and the current input was increased. The iron losses did not increase materially with age except where, owing to careless treatment or the armature running in contact with pole faces owing to wear of bearings, the laminations were burred over at the periphery. Welded joints were in use on the Manchester system, but they did not regard them as possessing any advantages over the fishplate joint. With double track efficiently cross-bonded, the service could only be stopped by the complete failure of four joints, one on each rail and all situated between the same two cross-bonds, a series of coincidences which could be safely neglected. The failure of more than one joint would be detected and located when carrying out the Board of Trade tests. In their suggested automatic control the rate of acceleration would adjust itself to the conditions of the track, and the motorman by means of his hand and emergency brakes would have full control of the stopping of the car, whilst by interconnection of the main switch with the brakes it could be made impossible to run with the brakes on. As regards meters on cars, their experience did not indicate any good results. A well-designed chain drive was far more silent than wheel gearing. The conical wearing of the motor pinions and gear wheels could not be due to bad alignment of bearings, as the wear was always at the motor end, and they ran new gearing with tight bearings, when the same wear soon became apparent. They did not agree with the use of porcelain insulation, as it was not calculated to withstand the shocks of tramway working, especially as they were not in favour of the ordinary primary insulation, and for all other purposes Globe and Brooklyn strain insulators were quite satisfactory. The experiments on the results of which this paper was founded had been carried out under strictly practical conditions, and had been approved by several leading engineers.

Discussion on Alderman Linsley's Paper.*

Alderman T. Smith (Leicester) thought that provision for inefficient employés ought to be undertaken by the State, as authorities which had municipalised tramways, &c., would have a much larger responsibility than those which had not done so. Trade unions were the greatest opponents to any scheme adopted by municipalities to meet such cases. Men who belonged to unions and friendly societies gave up their membership when they entered municipal employment, feeling that they were now in assured positions, and in that respect municipalities were in a much worse position than private employers.

Councillor McC. Hill (Bournemouth) said that it was a condition of employment by the Bournemouth Corporation that every man should be, and continue to be, a member of a friendly society.

Alderman G. F. Travis (Southport) pointed out that it would pay a corporation to contribute to the maintenance of superannuated employés, on the score of the increased efficiency obtained by the employment of younger men; but the objection was that men outside Corporation service would then be contributing to the support of men whose position was more secure than their own. A national compulsory system was desirable.

Bailie J. McFarlane (Glasgow) did not agree with Alderman Smith. Their scheme at Glasgow had been a great success from the first, and would be an object lesson to many other departments. Their relations with the men were of the most agreeable kind; they were paying a large number of men half-wages because they were unable to work.

Councillor W. C. Fenton (Sheffield) referred to the difficulty that arose through old and unfit employés being engaged in consequence of undue pressure placed upon the managers, and thought that every Council should have a standing order that no member should recommend any man to the manager for employment. At Sheffield they were paying about £2,500 a year to men who were practically unfit for their employment, with consequent risk of accidents. It was no good waiting for national insurance. The tramway concerns should pay a fixed sum towards a superannuation fund to which the men would also contribute.

Alderman Trumble (Croydon) pointed out that the capital of municipal tramway undertakings was not invested by the ratepayers, who therefore had no right to claim large dividends in the way of reduction of rates before employés and others received consideration. Provision for the depreciation of the men should be made by the large undertakings just as for that of machinery and rolling stock. At Croydon the men contributed a small amount weekly, to which the Corporation added a like amount; if a man resigned or were dismissed, he received his own contributions plus 2½ per cent. interest; but if he completed 20 years' service or was incapacitated through sickness, or in case of death, he received the whole amount with compound interest at 2½ per cent. The scheme was voluntary, and applied to all departments of the Corporation, which were represented on the Committee of management; and any such scheme should be equally comprehensive.

Mr. James Dalrymple (general manager, Glasgow) said that motormen and conductors were not in the same position as ordinary workers; the latter could go on working, though less efficiently, when aged, but drivers must be taken off at the first sign of breaking up, and might then be unfit for a conductor's duties. The time would come on every system when work could not be found for these men, and as they could not be cast adrift, it was desirable to set aside a sum annually in respect of each man's future main-

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* Elec. Rev., Oct. 2nd, p. 567.

tenance. At Glasgow the men contributed 6d. a week each, to which the Corporation added 3d., and this provided 15s. a week during sickness; for superannuation the men and the Corporation each contributed 1d. per week per man, and in a year or two they would have £30,000 or £40,000 at their disposal, which would enable them to maintain men absolutely past work. It was not a question for actuaries, who knew nothing about the conditions of the employment. Men who left the service, left their contributions in the fund. He advised them to lose no time in starting a similar scheme in the tramways departments, which differed essentially from the other departments.

Councillor C. F. Spencer (Halifax) referred to the difficulty of introducing any scheme where an annual deficit was being made. He thought any such scheme should apply to all Corporation employés, and that special legislation was necessary to deal with the matter.

Alderman Linsley briefly replied to the discussion.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Falk, Stadelmann's Fittings.

An advance copy is before us of the new catalogue (No. 279) issued by Messrs. Falk, Stadelmann & Co., Ltd., of Farringdon Road, E.C. It displays well on enamelled paper, in the course of some 150 pages, a fine array of electric fixtures, many of which demonstrate the high state of excellence to which the art designer, with the aid of the metal-worker, has brought his work for fittings of this kind.

Practically the whole fittings ground is covered, the collection including a variety of designs of brackets, ceiling fittings, hall lamps, electroliers, standards, dressing-room pendants and adjustable dining-room pendants, at a convenient range of prices. There

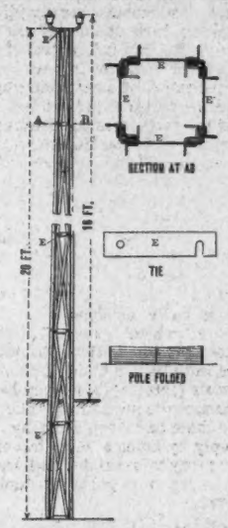
Falk, Stadelmann Fittings.

is also a fine group of correctly executed period fittings represented in Adams, Louis XV and Louis XVI, Queen Anne, Georgian and Dutch styles, typical of the standard of metal craft which is in favour at the present day.

A few selected designs of crystal fittings are illustrated, from single-light drop pendants to a massive 15-light lustre in fine cut glass, with ormolu Empire enrichments, suitable for a ballroom. A series of church fittings is shown, and others are made to conform to special schemes to architects' specifications. Among the bronze figures is a collection of new models. For the convenience of contractors' customers, fittings have been separated into groups, so that all brass fittings, including various oxidised finishes, will be found together, as will also wrought-iron fixtures, period fittings, &c. We understand that everything shown in the catalogue (excepting bronzes, which are peculiar to the Continent) is of English manufacture.

Extensible Poles.

In *Le Génie Civil* recently there appeared a description of the Delagneaux steel lattice or lazy-tongs poles, which can be folded up into a very small space for transport, and readily extended to a length of some 20 ft. The poles are provided at the joints with distance-pieces or ties, which when hooked into place prevent change of shape, by maintaining the axes of articulation at fixed distances apart; these also enable the length of the poles to be adjusted to suit requirements. The poles, being built up of standard

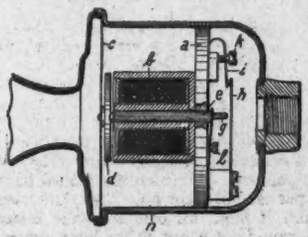


Delagneaux Folding Poles.

parts manufactured in large numbers, are very cheap and easily assembled, while their lightness and compactness render them peculiarly suitable for transportation. They can also be readily taken down and re-erected in new positions if necessary. The accompanying figures show the construction of the poles.

Electrical Hooter.

In the *E. T. Z.* for October 1st there is described an electric horn, devised by Messrs. Mix & Genest, Berlin, of which we give a section herewith. On the base-plate *a* a pot magnet *b* is carried having a hollow core; opposite the magnet is the diaphragm *c*, to which is attached the disk-shaped armature *d*. A rod *e* passing



Electrical Hooter.

through the core is pressed against the armature *d* by a spring, and bears a prolongation *g*, which, when the armature is attracted, breaks the current by striking the spring *h*, and knocking it away from spring *i*; *k* and *l* are adjusting screws. The apparatus is housed in a case *n*. It is worked with a pressure of 4 volts D.C., or a small alternator (as used in the German Reichstag).

OUR LEGAL QUERY COLUMN.

[*Questions addressed to this column should be written on one side of the paper only.*]

"S. G. L." writes:—"In an action which was reported in the papers on May 28th last, the National Telephone Co. appealed from a decision in favour of the Postmaster-General. I should be glad if you could tell me what is the position of the private contractor in the following circumstances:—(*a*) Can I erect a wire on a private line of poles and connect up three different factories at one end to their respective offices in a distant town at the other end? From my reading of the verdict I can. (*b*) If I should establish this party line, what is my position as contractor if I guarantee the service, should the next appeal reverse the last decision?"

*** It is plain, having regard to the decision to which we have been referred, that the telephone system in question will be perfectly lawful. If, however, the decision is reversed, and it should be held to cover the facts in the present case, "S. G. L." would be liable under his guaranty. Everyone is presumed to know the law howsoever it may be determined by the House of Lords.

"Inquirer" writes:—"I shall be obliged if you will kindly let me know through the medium of your 'Legal Query Column,' if it will be lawful for a municipal authority working under a pro-

visional order to give entire supply to a large works the greater portion of which is in their own area of supply, and the remainder in that of an adjoining supply authority.

"The municipal authority's service lines, meters, &c., would be in their own area, and the owners of the works would distribute the energy.

"Would the intervention of a motor-generator solve the difficulty if not allowed to supply as above?

"If it were deemed to be an unlawful act, who would be legally responsible, the supply authority or the consumer, and what would be the probable penalty?"

*** It is provided by Sec. 4 (2) of the Electric Lighting (Clauses) Act, 1899, that undertakers shall not, at any time after the commencement of the special order, supply energy, or erect, or lay down any electric lines or works beyond the area of supply otherwise than under the authority of Parliament, or under a licence granted by the Board of Trade. If undertakers supply energy, or erect or lay down electric lines or works in contravention of this Section, the Board of Trade may, if they think fit, revoke the special order on such terms as they think just. This clause is of general application throughout the country, but a similar clause is inserted in County of London Orders. There is no case which deals with the supply of electricity to works which are partly within and partly without a particular district; but the point has arisen in relation to the supply of gas. In Gas Light and Coke Co. *v.* South Metropolitan Gas Co., 62 L.T. 126, a gas company at the request of a railway company placed a meter on a part of a railway station lying within the company's limits, and through it supplied gas to other parts of the premises situated outside the company's limits, and within the limits of another company. The Court of Appeal held this to be lawful, on the ground that the sale and delivery of the gas took place at the meter, but the House of Lords reversed this decision, holding that the gas was supplied where it was consumed, and that there the company were transgressing their authorised limits. This case seems to cover the facts put forward by "Inquirer"; the distinction being that here it is only a question of supplying electricity to one comparatively small factory. At the same time, the inconvenience occasioned to a manufacturer whose premises happened to be on the boundary line by having to get his supply from two authorities, is such that there would probably be little risk in the adoption of the proposed course. With regard to the use of a motor-generator, it is difficult to see how this would render legal what was illegal before. The energy, although transformed, would still be energy supplied by the undertakers.

THE BRITISH ASSOCIATION MEETING AT DUBLIN.

Report of the Committee on Practical Standards for Electrical Measurements.

(Concluded from page 416.)

In Appendix I, Mr. F. E. Smith, A.R.C.Sc., gives an account of the secular changes of the standards, of resistance at the National Physical Laboratory, and brings together all the information available on the subject. At the National Physical Laboratory, the primary standards of resistance are of mercury, which have remained constant. The secondary standards are of various metals and alloys. Those of platinum have probably kept constant; the platinum-iridium, gold-silver, and a few of the platinum-silver coils have changed considerably, though some of the platinum-silver coils have kept very nearly constant; a few of the manganin coils have also remained very nearly constant, but most of them have increased in resistance. Following are extracts from the report:—

On all occasions when mercury standards were erected, the resistance coils were measured in terms of the mean unit represented by the mercury columns, with a probable error of about five parts in 1,000,000. The probable error of the resistance values assigned to the manganin standards on any date is almost certainly less than one part in 100,000.

Mercury Standards.

The mercury standards of resistance are 10 in number, and were constructed in 1902-3. The mean international ohm as realised by the 10 standards is taken as the unit, and each tube is measured in terms of it. In practice two manganin coils act as intermediaries. The measured values in 1903 and 1907 are given in Table I.

With the exception of P the relative values of the standards have kept remarkably constant, and in the case of P the increase in resistance may be apparent only, for only in 1907 has an increase been noted. The relative values of the French mercury standards in 1885 and 1905, and of the mercury standards of the Reichsanstalt in 1893 and 1904, are also in very good agreement.

Wire Standards.

The original coils of the Association are six in number: two are of platinum, two of platinum-iridium, one of gold-silver, and one of platinum-silver. They were compared together by Messrs. Matthiessen and Hockin in 1865-7, by Messrs. Chrystal and Saunder in 1876, by Dr. Fleming in 1879-81, by Dr. Glazebrook and Mr. Fitzpatrick in 1887-8, and by the author in 1908. In addition to these six coils, Messrs. Chrystal and Saunder examined a platinum-silver coil marked No. 29 F, and also a coil known as Flat, while measurements of another platinum-silver coil H are given in the report for 1888. These coils—in all, nine—have remained in charge of the secretary.

TABLE I.

Giving the Values of the Mercury Standards in 1903 *and* 1907.

Mercury standard.	Value in mean International ohms.		Difference 1907-1903.
	1903.	1907.	
M	$0{\cdot}97170_5$	$0{\cdot}97169_9$	$-\ 0_6$
P	$1{\cdot}00038_7$	$1{\cdot}00042_1$	$+\ 3_4$
T	$1{\cdot}00019_5$	$1{\cdot}00020_6$	$+\ 1_1$
U	$0{\cdot}97349_7$	$0{\cdot}97348_8$	$-\ 0_9$
V	$1{\cdot}00137_9$	$1{\cdot}00137_1$	$-\ 0_8$
X	$1{\cdot}00106_8$	$1{\cdot}00106_0$	$-\ 0_8$
Y	$1{\cdot}00026_7$	$1{\cdot}00026_5$	$-\ 0_2$
Z	$1{\cdot}00130_6$	$1{\cdot}00129_9$	$-\ 0_7$
G	$1{\cdot}00105_2$	$1{\cdot}00104_4$	$-\ 0_8$
S	$1{\cdot}00097_4$	$1{\cdot}00097_2$	$-\ 0_2$

The unit, in terms of which the measurements of 1879-81 were made, is the mean B.A. unit as indicated by Fleming on his chart; it is supposed to represent the mean of the resistances of the six coils A, B, C, D, E, G at the temperatures at which they were originally correct. It is this unit which was used by Lord Rayleigh in his work on the ohm, and by Dr. Glazebrook since about 1880, and it has been closely adhered to in all measurements made by the committee since that date.

A close examination of the chart at the present day shows that the mean of the values of the six coils is really about 0·99985 unit; hence if this interpretation be accepted, the mean B.A. unit is really 15 parts in 100,000 less than the units which has been taken since 1880; but it has not been thought wise to attempt any correction on this score.

The chart gives the values of the coils from 0° C. to 25° C., and the graphs are such that the value of a coil can be read with an error not greater than 3 parts in 100,000, which is equivalent to a change in temperature of 0·1° C. of a platinum-silver coil. The resistances of the coils at various temperatures as given by the chart are given in Table II:—

TABLE II.

Giving the Values of the Coils in 1879-81, *from Fleming's Chart.*

Coil.	Temperature at which coil was stated to be correct in 1867.	Value of coil, from Fleming's chart, at temperature given in 1867.	Value of coil, from Fleming's chart, at 16·0° C.
A	16·0° C.	1·00011	1·00011
B	15·8° C.	1·00006	1·00035
C	15·3° C.	1·00007	1·00056
D	15·7° C.	0·99960	1·00052
E	15·7° C.	1·00010	1·00102
F	—	—	0·99971
G	15·2° C.	0·99916	0·99937
Flat	—	—	1·00034

Changes of very considerable magnitude have taken place, and the task before us is to select the most constant and the most variable coils.

We conclude that B and E have possibly remained constant during the period 1867-1908, and that C and D are next in order of constancy. The coils D and E have remained relatively constant since 1876.

Dr. Glazebrook in 1888 measured the B.A. unit in terms of the specific resistance of mercury, and found that the value of the resistance of a column of mercury, 1 metre long, 1 sq. mm. in section, at 0° C. was 0·95352 B.A. unit.

In 1908 the individual coils were compared with the new mercury standards set up at the N.P.L., and their values found in terms of mercury. If we assume that the mean value of the coils A, B, C, D, E, G is the same as when Fleming's chart was constructed, we obtain as the resistance of 1 metre of mercury, 1 sq. mm. in section, at 0° C., the value—

0·95333 B.A.U.,

an alteration of 20 parts in 100,000 since 1888.

If, on the other hand, we suppose that the mercury units set up in 1908 agree exactly with those constructed in 1888, then the mean value of the six coils in question has altered by 0·00020 B.A.U.

It appears to be practically certain that the coils B, D, E and H have the same resistance in 1908 as they had in 1888. The agreement of the values for D and E is very remarkable, for the temperatures at which these coils were believed to be correct in 1888 are stated to the nearest tenth of a degree only; an apparent change in resistance of 15 parts in 100,000 would, therefore, have been negligible. With respect to G, it has risen by over 1 part in 1,000 during the past five years, and Flat changed by 17 parts in 100,000 in 1902. The fluctuations in the value of H are believed to have amounted to about one part in 10,000 during the period 1888-1908.

We believe the two platinum coils have remained constant in resistance since 1867, and that the values in 1867, 1879-81, 1888, and 1908 of these and other coils in terms of the original B.A. unit (1867) are as follows:—

TABLE VII.

Resistances at 16·0° C. in terms of the original B.A. Unit (1867).
(Values obtained through the two Platinum Coils D, E.)

Coil	Material	1867	1876	1879—81	1888	1908	Maximum difference.
A	Pt. Ir.	1·00000	1·00077	1·00056	1·00147	1·00122	147 × 10⁻⁵ B.A.U.
B	Pt. Ir.	1·00029	1·00121	1·00080	1·00104	1·00098	92 ,,
C	Au. Ag.	1·00050	1·00141	1·00101	1·00146	1·00178	128 ,,
D	Pt.	1·00092	1·00092	1·00092	1·00092	1·00092	0 ,,
E	Pt.	1·00152	1·00152	1·00152	1·00152	1·00152	0 ,,
F	Pt. Ag.	—	—	1·00016	1·00072	1·00160	144 ,,
G	Pt. Ag.	1·00022	1·00030	0·99982	1·00025	1·00175	193 ,,
H	Pt. Ag.	1·00020	—	—	1·00042	1·00044	24 ,,
Flat	Pt. Ag.	—	—	1·00079	1·00120	1·00125	46 ,,

It is clear that the maximum number of coils which can have kept constant is two, and if the platinum coils have not remained constant then one only of the other coils can have done so. Since D and E are of pure platinum, and not of an alloy, it is probable that these would change least.

If our conclusions are correct, the results are not only of some value as showing the changes which may take place in the resistance of certain alloys when embedded in paraffin wax, but they are also of value because the coils link together so many determinations of the ohm in absolute measure and of the specific resistance of mercury. It is not convenient to collect the various determinations here, but as an instance of the uses to which the data given in this appendix might be put we take Lord Rayleigh's and Mrs. Sidgwick's determination in 1881 of the specific resistance of mercury.

The difference in 1881 of coils F and Flat from the values given by Lord Rayleigh, calculated from the data now given, is three parts in 100,000, which is less than the probable error of the observations. We conclude, therefore, that the determination of Lord Rayleigh and Mrs. Sidgwick in 1881 is in excellent agreement with that made at the National Physical Laboratory in 1908, and this latter has been shown to agree with that made by Dr. Glazebrook in 1888.

It is of some importance to note that in 1892 the ratio of the B.A. unit to the ohm was accepted as being

$$1 \text{ ohm} = 1{\cdot}01358 \text{ B.A. unit},$$

this being based on the values

$$100 \text{ cm. mercury} = 0{\cdot}9535 \text{ B.A. unit.}$$
$$106{\cdot}3 \text{ cm. mercury} = 1 \text{ ohm.}$$

Manganin Standards of Resistance.

The manganin standards of the National Physical Laboratory are in constant use and have proved of very great value. They not only facilitate electrical measurements, but they bring them to a far higher degree of accuracy than was formerly attainable. Nevertheless, the variations in these resistances have in many cases been a source of trouble, and attempts have been made, and are been continued, to construct standard coils of manganin which shall remain practically constant in resistance.

Since 1903 the manganin standards have been intercompared at least four times every year and the probable changes have been deduced from occasional comparisons with mercury standards and from tables of difference values, due regard being also paid to the past history of the coils.

The unit coils have varied during the past five years by the following amounts:—

TABLE XII.

Coil.	Maximum change in resistance in five years.	Difference value. Resistance in 1908 — resistance in 1903.
1,690	3·7 × 10⁻⁵ ohm.	3·7 × 10⁻⁵ ohm.
780	4·6 ,,	4·6 ,,
2,351	7·8 ,,	− 0·2 ,,
2,483	4·4 ,,	3·2 ,,
381	2·6 ,,	− 0·2 ,,
L·17	10·2 ,,	9·6 ,,
L·18	8·8 ,,	8·8 ,,
	Mean = 6·0 ,,	Mean = + 4·2 ,,

If we neglect L·17 and L·18, the mean value of the other five coils is 2·2 × 10⁻⁵ ohms greater in 1908 than in 1903.

The mean difference in the values of all the manganin coils for 1908 and 1903 is 12·6 parts in 100,000. The oldest coils are 17 and 13 years old. The remainder of the coils are from five to eight years old.

In general the older the coil the more constant does it appear to be.

The possible causes of the changes in the manganin resistances may be classified under the following heads:—

1. Change in structure of the alloy.
2. Surface action.
3. Humidity effect.
4. Change in the soldered joints connecting the wires of high-resistance coils to the current leads.
5. Change at the junctions of the potential leads with the resistance standard.

Only the first of these appears to fully explain the gradual rise in resistance. Causes 2 and 4 would have an inappreciable effect on very low resistances; yet some of these have changed by considerable amounts. Cause No. 5 would have no effect on high-resistance coils, since these are not provided with potential leads; but all of the high-resistance coils have changed. Cause No. 2 produces in general a cyclic change, and, while being without doubt a cause of variation, it cannot be modified to explain all the gradual increases in resistance, owing to the negligible effect of humidity on very low-resistance standards. Cause No. 1 appears, therefore, to have been the chief agent in the cases we have considered.

In 1903 the resistances were measured of some manganin coils (1 to 5,000 ohms) in a box by R. W. Paul, London. The coils could not readily be immersed in oil, and the measurements were, therefore, uncertain to about 1 part in 100,000. The resistances were again measured in 1904, 1906, and December, 1907. The maximum change in the resistance of any coil is 5 parts in 100,000, while the mean increase in resistance during 1903-7 is 4 parts in 100,000.

Of the manganin standards examined, some have kept remarkably constant, while others are practically useless as standards. It must not be concluded, however, that all manganin resistances are subject to such changes. Drs. Jaeger and Lindeck have shown that the manganin standards of the Reichsanstalt keep very constant, and the manganin coils at the Bureau of Standards also appear to be of a fairly constant type, though subject to considerable cyclic changes owing to variable atmospheric humidity.

APPENDIX II.

Specification for the Practical Realisation of the Definition of the International Ohm.—The international ohm shall be equal to the resistance offered to an unvarying electric current by a column of mercury at the temperature of melting ice, 14·4521 grammes in mass, of a constant cross-sectional area, and of 106·300 centimetres in length, arranged in accordance with the following specification.

The column of mercury shall be of circular section, or nearly so, and shall be contained in a tube of suitable glass which has been carefully annealed. The tube shall be straight to the eye, and the maximum variation in its area of cross-section shall not exceed 2 parts in 100. The tube is to be carefully calibrated, and the correction for its conicality determined.

In determining the weight of mercury contained by the tube when filled at the temperature of melting ice, the column of mercury is to be bounded by planes at the terminal cross-sections of the tube. The tube should not be unduly heated, and it should be filled with mercury by exhaustion of air.

The axial length of the tube should be measured at 0° C. if possible, otherwise the coefficient of expansion of the glass should be determined and the axial length of the tube at 0° C. calculated from axial measurements made very near to that temperature. To facilitate measurements of the axial length, the ends of the tube should be ground very slightly convex.

For the electrical measurements the ends of the tube are to be connected to spherical bulbs of glass, the slightly convex ends of the tube forming, very nearly, portions of the internal spherical surfaces of the bulbs. Each bulb is to be provided with a current and a potential lead, the point of entry of the former, and an end of the tube being at opposite ends of a diameter of the bulb. The potential lead shall be situated in a plane midway between the point of entry of the current lead and the end of the tube, and at right angles to the line connecting them.

Contact with the mercury shall be made by means of platinum wires.

The diameter of a bulb is to be from 30 to 33 times the diameter of the terminating section of that end of the tube to which it is connected.

If L is the axial length in centimetres of the mercury column contained by the tube at 0° C., W the weight of the column in grammes, and μ the correction for the conicality of the tube, the resistance of the column at 0° C. is

$$\mu \frac{L^2}{(106{\cdot}300)^2} \cdot \frac{14{\cdot}4521}{W} = 0{\cdot}001278982\ \mu \frac{L^2}{W} \text{ international ohms.}$$

When the spherical bulbs are fitted to the ends of the tube, and the whole filled with mercury, if r is the mean radius of the tube, and r_1, r_2 the mean radii in centimetres of the terminal sections, the resistance at 0° C. between the potential leads is—

$$0{\cdot}001278982 \frac{L^2}{W} \left\{ \mu + \frac{0{\cdot}80\, r^3 \left(\frac{r_1 + r_2}{r_1\, r_2} \right)}{L} \right\}^* \text{ international ohms,}$$

correct to 1 per cent. of the added resistance—

$$0{\cdot}001278982 \frac{L}{W} \left\{ 0{\cdot}80\, r^3 \left(\frac{r_1 + r_2}{r_1\, r_2} \right) \right\}^*$$

* The end correction factor is given in these formulæ as 0·80; this value is, however, subject to amendment.

The electrical measurements are to be carried out at 0° C., the tube and spherical vessels being surrounded by melting ice and about 15 centimetres below the upper surface of the ice. The connecting wires employed for the current and potential leads must be thin, the flow of heat through them to the mercury being insufficient to warm the mercury so as to produce appreciable error.

The insulation resistance between the mercury column and the ice surrounding the tube must not be less than 10,000,000 ohms.

E

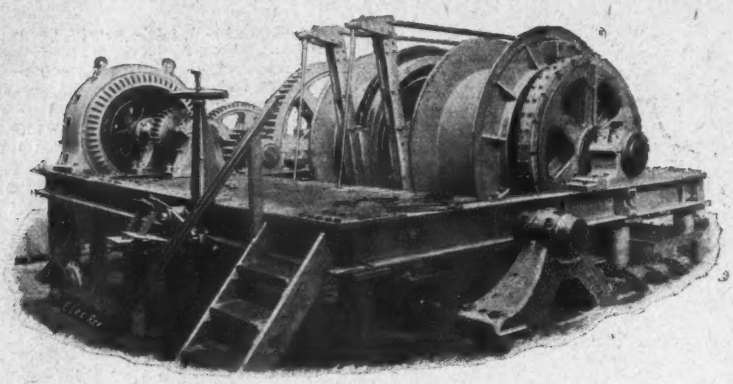


Fig. 1.—Scott & Mountain 350 h.p. Main and Tail Haulage.

The current employed in comparing the mercury resistance with other resistances shall be limited by the condition that the mercury shall not be warmed sufficiently to produce appreciable error.

The mean of at least five tubes must be taken to determine the value of the mercury unit.

The mean of at least three fillings shall be taken as the value of the resistance of a tube.

Specifications for the practical application of the definition of the international ampere, and for the preparation of the Weston cadmium standard cell, are also given, generally similar to those published in our issue of August 16th, 1907.

A LARGE HAULAGE GEAR.

A large number of mining engineers visited the works of Messrs. Ernest Scott & Mountain on Saturday last, for the purpose of seeing at work a large main and tail electrically-driven haulage, which has been built to the order of Messrs. Pease & Partners for their Loftus Mines, and which is to be driven by three-phase current taken from the mains of the Cleveland and Durham Electric Supply Co.

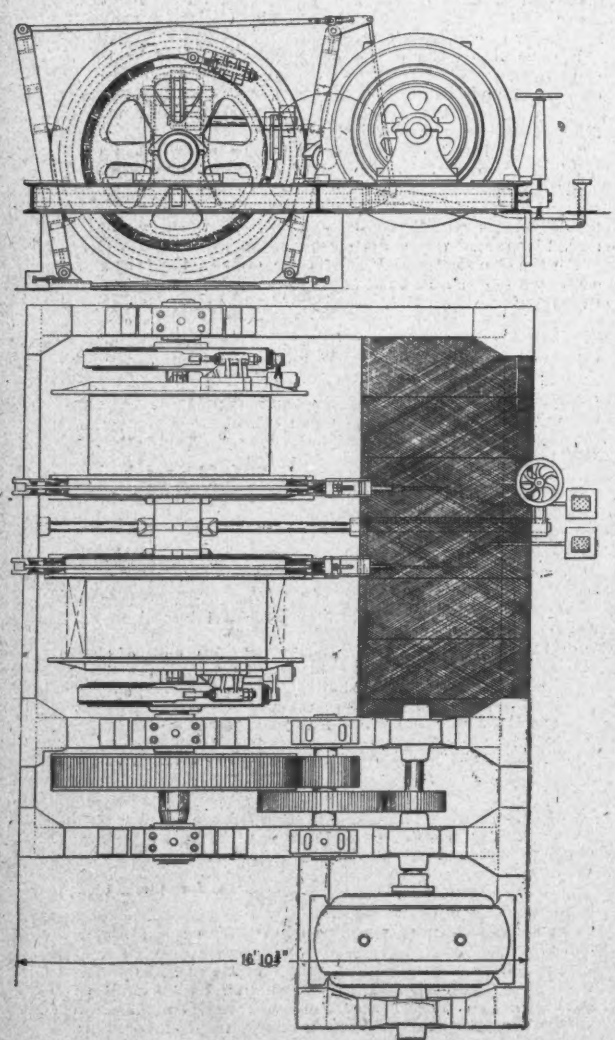
The haulage gear, as will be seen from the accompanying figs. 1, 2 and 3, consists of two drums, each 6 ft. diameter × 32 in. wide, which run loose on a shaft, 11 in. diameter, between two bearings, the journals of which are 10 in. diam. × 15 in. long. A third bearing of the same size carries the outer end of the shaft to support the large spur wheel. This latter wheel is keyed to the drum shaft and is driven through double-reduction gearing by a slip-ring three-phase motor of 350 h.p. capable of working up to 400 h.p. for short periods, and is thus one of the largest—if not the largest—main and tail haulage gear ever constructed. The motor is designed for 2,750 volts pressure and 40 cycles, and runs at a speed of 345 r.p.m. while the rope speed of the drums is 9 miles per hour. The following are the principal dimensions:—

Drums.—Diameter on tread, 6 ft.
Revolutions per minute, 38·5.
Rope speed, 9 miles per hour.
Diameter of rope, 1 in.
Diameter of brake path, 7 ft. 6 in. × 6 in. wide.
Diameter of shaft, 11 in.
Diameter of bearings, 10 in. × 15 in. long.

Gearing.—Diameter of second motion shaft, 9¼ in.
Two bearings, 8 in. diameter × 12 in. long.
Diameter of first motion shaft, 6½ in.
Three bearings (including motor bearing), 6 in. × 20 in. long.

Main Gear.—Spur wheel, cast-iron, 75 teeth, 4 in. pitch.
Pinion, cast-steel, 19 teeth, 4 in. pitch.
First motion spur wheel, machine-cut, cast-steel, 65 teeth, 2½ in. pitch.
Motor pinion, ditto, 30 teeth, 2½ in. pitch.

Motor.—Three-phase 350 h.p., 52 in. diameter × 16 in. wide.



Figs. 2 and 3.—Elevation and Plan of Scott & Mountain Haulage Gear.

Each drum is driven by means of a Hall's friction clutch, which consists of a mild steel strap lined with wood blocks, as will be seen on the right in fig. 1, taken from a photograph of the gear as erected in the shop. This strap is fixed by means of a strong bracket to the drum side at one end, and to a movable arm pivoted to a bracket also connected to the drum side at the other end. The movable arm is coupled by means of rods and levers to the hand wheel on top of the pillar shown in the front of fig. 1. The strap embraces a friction wheel keyed to the shaft, and consequently as the hand-wheel is turned the strap is gradually tightened until the load is slowly started. After starting, the clutch is allowed to slip until the ropes are tightened up, and the main or tail drum, as the case may be, begins to move, and the set gets into motion, when the strap is further tightened, and the slipping reduced until the drum is running at full speed. The object of this arrangement is to prevent the constant stopping and starting of the motor, though a massive controller is provided to start the motor under full load if necessary. In ordinary working, however, the motor and gearing is constantly running, and either the main or tail drum is started by the friction clutch. Each drum is provided with a powerful post brake, controlled by foot levers near the clutch pillar, as shown.

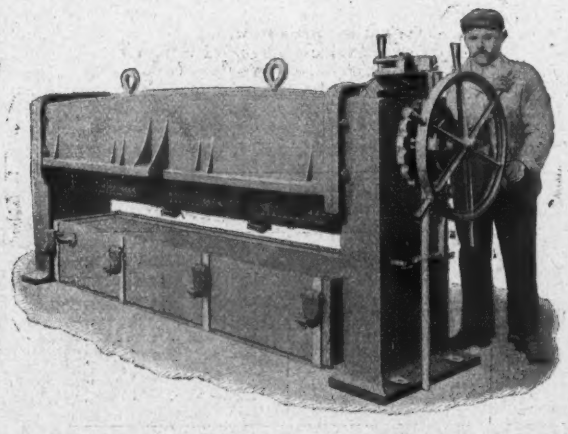


Fig. 4.—Controller for 350 h.p. Electrical Haulage Gear.

Whilst the above method of starting the drums may be quite satisfactory when everything is working smoothly, yet it often happens that things go wrong and it becomes necessary to stop the

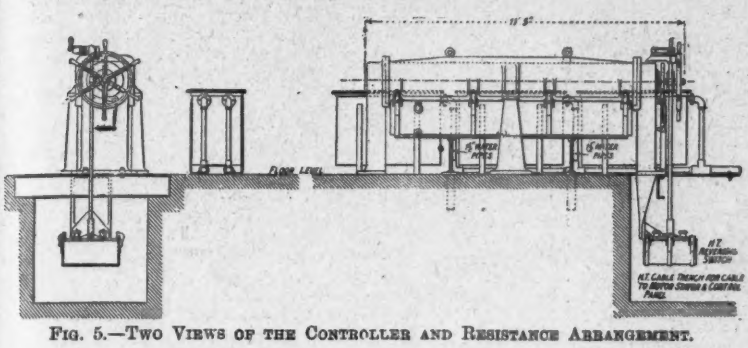


FIG. 5.—TWO VIEWS OF THE CONTROLLER AND RESISTANCE ARRANGEMENT.

motor and to start up again under full load, and further, it may be necessary to run at a lower speed, which at once introduces a serious difficulty, as experience has shown that to start and regulate the speed of such large three-phase motors is not an easy matter. The ordinary drum-type controller is most unsatisfactory, even when immersed in oil, and large liquid controllers demand considerable attention and are expensive in up-keep. In order, therefore, to overcome these difficulties, a new pattern reversible controller has been specially designed to enable the motors to be easily and smoothly started, and to give a 50 per cent. speed regulation continuously at full load, and also for running dead slow.

The controller is shown in fig. 4, and the arrangement of the controller and resistance boxes is shown in fig. 5. The controller consists of three sets of 16 quick-break and quick-make knife switches, each operated by a cam fixed to the central spindle. The switches, therefore, are out of the control of the operator, and cannot be held in an arcing position. The whole apparatus is enclosed in a strong cast-iron case, with a wrought-iron oil tank

FIG. 6.—REVERSING SWITCH AND OIL TANK.

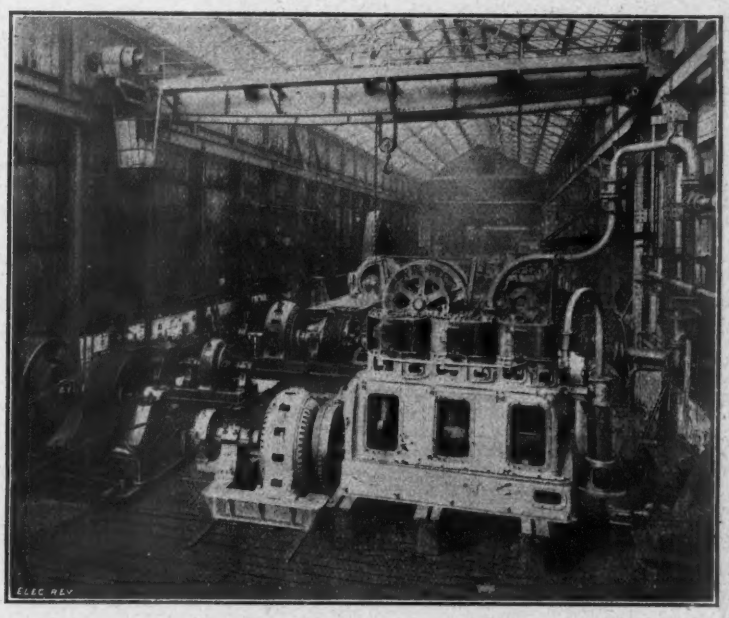


FIG. 8.—THE ERECTING SHOP, MESSRS. SCOTT & MOUNTAIN'S WORKS, GATESHEAD.

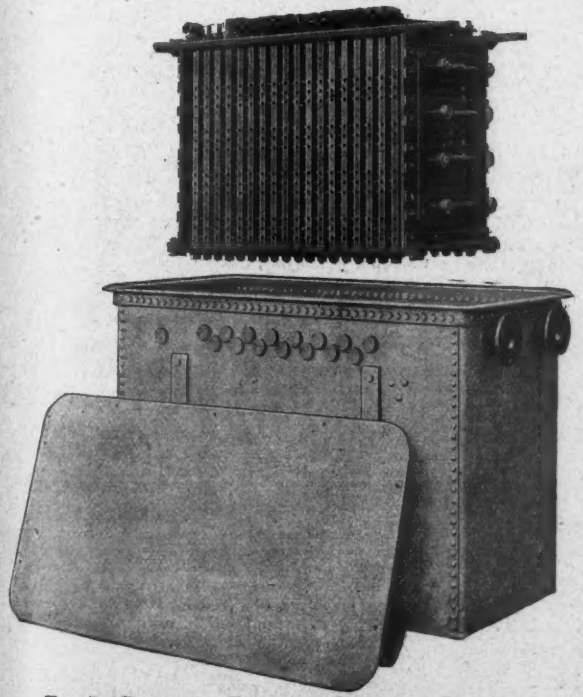


FIG. 7.—RESISTANCE TANK WITH RESISTANCE REMOVED.

suspended below, in which the switches make and break contact. At the front of the controller, and suspended in a pit below the floor level, is the reversing switch, also immersed in oil, and operated by a quadrant near the controller hand-wheel. The quadrant is interlocked with the hand-wheel, so that it can only be operated when the latter is in the "off" position and the motor at rest. This switch is shown in fig. 6, and the reversing is done by crossing two of the phases.

Alongside the controller are placed three resistance tanks—one for each phase—the resistance being self-contained and immersed in oil contained in the tank. Fig. 7 shows the resistance removed from the tank. In order to keep the oil cool the resistances are provided with a system of copper pipes through which cooling water is pumped. This latter is practically a necessity where large amounts of energy have to be dissipated, in order to keep the dimensions of the resistances down to a minimum.

In addition to the above, Messrs. Scott & Mountain also have an order for another three-phase motor of 350 H.P., for the same firm, to drive an existing haulage by rope gearing, and which was also on view. This can be seen in fig. 8, which shows the erecting shop, on the left immediately below the large haulage gear, while in the front on the right will be seen a 250-KW. three-crank high-speed engine and three-phase alternator, with direct-coupled exciter. The rope-driven haulage motor is provided with a King's friction clutch, which consists of two wood-lined straps, working on a rim cast with the rope pulley, and which are tightened by means of right and left-hand screws, operated by levers, and a sliding boss on the shaft. This motor is supplied with current at 2,500 volts pressure and 40 cycles, and is provided with a reversing controller as described above.

Fig. 9 shows the stator of a 1,000-K.V.A. alternator for the Coltness Iron Co, which is to be driven by a gas engine supplied with blast-furnace gas, the windings having been specially treated to protect them from gas fumes. The revolving field is mounted on the crankshaft of the engine and weighs about 14 tons, the complete weight of the alternator being about 30 tons. The machine is to generate three-phase current at 2,500 volts pressure and 25 cycles.

Several other machines in course of construction were also shown

to the visitors, among which were two large three-throw pumps, one for Swanwick collieries having rams 12 in. diameter by 18 in. stroke, capable of delivering 700 gallons of water per minute against a head of 540 ft., and arranged for rope drive from a 150-H.P. three-phase motor, and the other designed for 750 gallons of water per minute against a head of 700 ft., the rams

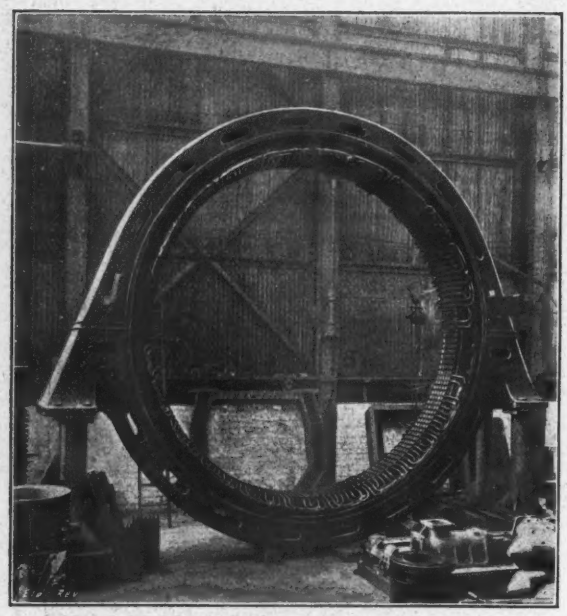


Fig. 9.—Stator for 1,000-K.V.A. Alternator.

being 12 in. diameter by 15 in. stroke. Among the steam generators were two compound enclosed steam engines of 370 B.H.P., coupled direct to three-phase alternators of 250 KW., 600 volts and 40 cycles, running at a speed of 343 R.P.M., the steam pressure being 145 lb. per sq. in., for the Newbiggin Coal Co.

Other work in progress includes various haulage gears for both main and tail and endless rope systems, three-throw pumps, horizontal centrifugal turbine pumps and a vertical centrifugal direct electrically-driven pump for sinking or unwatering shafts.

BUSINESS NOTES.

Consular Notes.—Ecuador.—A contract has been entered into between William L. Russell, an American subject, and the Government of Ecuador, whereby the former agrees to establish telephonic communication between Quito and Guayaquil and the intermediate towns, and to establish systems in the towns themselves. For the space of 10 years Mr. Russell will receive a monthly subvention of 2,000 sucres (sucre = 2s.) from the State, payment to begin as soon as the Quito-Guayaquil line is ready. In return the Government are to have free use of the line, but if the number of calls exceeds the number to which 2,000 sucres per month would give the right, the Government will pay half the fees for calls above that number. The concession is to last for a period of 25 years, and during that period free importation of any material for the line will be allowed, as well as exemption from State and municipal taxes. The subscription for every telephone in the town is limited to 5 sucres per month.

Russia.—The Austrian Consul at Baku reports that the importation of electric lighting and other electrical materials into that district is on the increase. Hungarian works have found a good market, but electric motors are imported almost exclusively from Germany. The question of the electrification of the Baku tramways, which has been under discussion for some years, came to the front again in 1907, and it would appear that the execution of this project has been decided on, since a large company, which proposes to install electric power for boring works in the naphtha industry, has prepared a project whereby the municipality will be able to install electric traction on the tramways without the outlay of any capital, and under very favourable circumstances. A considerable demand will thus be created for electrical materials, rolling stock, &c., necessary for the new system.

India.—The *Review of the Trade of India* in 1907-8 recently issued states that the total of the various classes of machinery imported into India in the last three years were as follows:—

	1905-6.	1906-7.	1907-8.
Textile	£1,660,000	£1,516,000	£1,755,000
Steam engines and parts ...	669,000	874,000	918,000
Electrical	158,000	180,000	198,000
Mining	50,000	42,000	52,000
Other sorts	747,000	1,248,000	1,467,000
Total	£3,284,000	£3,860,000	£4,390,000

The steady increase under all heads emphasises the growing industrial activities of the country. The figures for 1907-8 mark a total advance of £530,000, equivalent to 13·7 per cent. on the figures of the previous year. Bombay continues the premier port of import with a share of 44·7 per cent, and an increase of £242,000, chiefly under textile machinery. In Bengal the features of the year were increased demand for steam engines for mill work, particularly jute mills, pumping, and mining machinery, and in Madras there were marked increases under electrical and textile heads. The values of imports into the five principal maritime provinces, and the percentage of total imports during the year, were as follows:—

Bombay	£1,961,000	44·7 %
Bengal	1,773,000	40·4 %
Madras	295,000	6·7 %
Burma	249,000	5·7 %
Sind	100,000	2·3 %

The progressive expansion in the imports of railway material continues, and the figures have again attained the highest level on record. In the last five years they have been as follows:—

1903-4.	1904-5.	1905-6.	1906-7.	1907-8.
£3,758,000	£3,744,000	£4,493,000	£5,662,000	£6,592,000

The increase in the twelve months under review is equivalent to 16·4 per cent. These figures include rolling stock, and comprise imports for private lines £4,800,500 (as against £2,772,200 in 1906-7), and for State railways £1,791,000 (as against £2,889,600 in 1906-7). Detailed comparisons with the totals of previous years are vitiated by the transfer of railway administrations from time to time from one to another class. It may be noted that during the twelve months 985·16 miles of railway were opened, while 2,457·16 miles were under construction or sanctioned on March 31st, 1908. On the same date the total length of line open in India was 30,286·65 miles.

With regard to the trade in copper, the report states that not since 1887-8, when the Société des Metaux had temporarily cornered the world market, has the price of copper been so high as at the beginning of 1907, and this was chiefly due to the manipulation of powerful operators in America, who succeeded, by increasing the output of the mines and offering diminishing quantities for sale, to create the impression that consumption was outstripping production. When the accumulation of an enormous unsold stock was disclosed, at a time of great monetary stringency, the effect upon prices was sensational, and the year, which had opened with Chile bars at £106 10s. per ton, closed with a quotation of £60 15s. The Indian demand for the metal is comparatively small, in fact, less than $\frac{1}{10}$th annually of the world's estimated production. The advance recorded in the imports of the year 1907-8 should be attributed to the extending use of electricity in India rather than to any intensification of the demand for the metal for domestic utensils, which is peculiarly sensitive to the effects of seasonal adversity. Wrought copper represents 82 per cent. of the total copper imports. It increased in quantity by 31 per cent. The actual receipts amounted to 258,897 cwt., valued at £1,133,700, as compared with 197,416 cwt., valued at £861,600, in the previous year. The imports of unwrought copper came to 55,759 cwt. and £236,119, an increase of 324 per cent. in quantity and 279 per cent. in value. The bulk of the shipments was received in the latter part of the year, when the collapse of prices attracted Indian buyers, and the imports from April, 1908, onwards have continued on an unprecedently large scale. India's potentialities as a producer of copper are yet to be seen. Prospecting operations are in progress at Singbhum (Bengal), and diamond drilling has proved the persistence of the copper lodes to depths of over 1,000 ft., but it is still doubtful if their richness and thickness are sufficient throughout to warrant the capital outlay necessary for systematic mining.

Book Notices.—*Le Pérou d'Aujourd'hui et le Pérou de Demain.* By E. Guarini. Paris: Dunod & Pinat. Price 1 fr.—In this pamphlet Prof. Guarini, whose efforts to promote the welfare of his adopted country are untiring, describes the natural characteristics and resources of Peru, the backward condition of which he ascribes to the lack of motive power. Coal there costs 35·50 fr. per ton; but Peru is liberally endowed with water-powers comparable with those of Switzerland and Italy, and the author urges that these should be turned to account. In particular he advocates the claims of his pet scheme, the utilisation of the waters of Lake Titicaca, which is not only of immense area and volume, but, being situated at an elevation of 3,800 m. above sea level, possesses a potential energy of more than 21 million H.P.-years. The lake has no outlet to the sea, the inflow from the Cordilleras being balanced by evaporation from its surface; but it is estimated that a continuous output of five million H.P. could be obtained.

Unfortunately, to secure this, a tunnel through the mountain range 40 km. in length would be required—a very formidable and costly undertaking. In spite of the author's able review of the enormous advantages to be derived from an abundant supply of electrical energy, we fear that for many years Peru will have to be content with the development of the many more readily available water-powers within her boundaries.

Post Office Electrical Engineers' Journal, Vol. I. Part 3. October. London: H. Alabaster, Gatehouse & Co.—This issue is quite as interesting as any of its predecessors, if not more so. The following are the titles of a few of the articles:—"The New General Post Office (King Edward's Buildings)," by E. W. Pettit; the "Cult of the Clerk," by T. B.; "The Localisation of Faults on Underground Cables," by H. P. Brown; "Tapping on to Kroonstad: A Reminiscence of the Boer War," by J. H. B.; "The New Common Battery Exchange at Cardiff," by T. Devereux; "Development of the Post Office Long-Distance Trunk Exchange," by J. Stuart Jones and W. J. Medlyn; "The Post Office Radio-Telegraph Stations at Tobermory and Lochboisdale," by A. C. Booth; "The Effect of Wireless Telegraph Transmission on a Telephone System." A small supplement gives a list of officials in the Engineering Department of the G.P.O., also the Indian Telegraph Department Station List, and the Staff List of British East Africa and Uganda.

"Elementary Manual of Radio-telegraphy and Radio-telephony." By J. A. Fleming. London: Longmans, Green & Co. 1908. Price 7s. 6d. net.

"Neues vom Löten." Extract from the Proceedings of the Society for the Promotion of Industry. Berlin: G.m.b.H. Classen & Co.

"Proceedings" of the American Society of Civil Engineers. September, 1908. Vol. XXXIV, No. 7. New York: The Society.

"Science Abstracts." Sections A and B. September 25th, 1908. Vol. 11, part 9. London: E. & F. N. Spon. Price 1s. 6d. each part.

"The Fixing of Rates and Fares." By H. Marriott. London: The *Railway Gazette*. Price 2s. net.

"Atti della Associazione Elettrotecnica Italiana." Vol. XII, part 4. July and August, 1908. Milan: Rebeschini di Turati. Price 5 lire.—This number contains papers by Prof. Piola on magnetic permeability and on the resistance and reactance of a solenoid with iron core, and a paper by Prof. Artom on his system of radio-telegraphy.

Underfeed Stokers.—The following orders for mechanical underfeed stokers have recently been received by the Underfeed Stoker Co., Ltd.:—

Davey, Paxman & Co. (for Maidstone Corporation)	2 B5
Bahia Blanca Power Station	6 E
Blackstone & Co., Stamford	2 B5
Hanshin Railway Co., Japan	8 E
City of Birmingham Electricity Department	4 E
J. & P. Coats, Paisley	10 B5
Steamship *Paris*	3 D
Poplar Borough Council	2 E
Millaquin & Yengarie Sugar Co., Brisbane	14 B5
Société Minère et Metallurgique de Penarroga, Spain	10 E
Calcutta Tramways	1 E
Mines de Lens	8 E
Strassburg Electricity Works	2 E

Catalogues and Lists.—Dewhurst's Engineering Co., Ltd., Attercliffe Road, Sheffield.—Illustrated descriptive circular relating to their "Aqua-Drainer" and steam trap.

Messrs. J. Bagshaw & Sons, Ltd., Batley.—Small pocket price list of wrought-iron pulleys and cast-iron belt and rope pulleys.

The Electric Construction Co., Ltd., Bushbury Engineering Works, Wolverhampton.—New leaflet (A 306), in which they give a brief description, with illustration, of their E.C.C. haulage gears for underground work.

British Thomson-Houston Co., Ltd., Rugby.—Finely illustrated 16-page pamphlet entitled "Electricity in Rolling Mills," wherein they summarise the advantages of electric power in this connection, and describe their motor-generators, switchboards, D.C. mill motors, controllers and other equipments for such operations.

Mason's Gas Power Co., Ltd., Alma Works, Levenshulme, Manchester.—New catalogue consisting of a number of well-printed sheets in expanding binder, describing the "Duff" single and coupled cell gas producers, bituminous coal gas power plant, "Weardale" furnaces, and combined "Duff" gas producer and forging furnace. A large number of diagrammatic illustrations appear.

Messrs. E. Brook, Ltd., Colne Road, Huddersfield.—Monthly (October) price list of single-phase motors in stock.

E.M.F. Manufacturing Co., London.—An attractive show-card in colours, in the form of a large E.M.F. metal-filament lamp, informs all and sundry that these lamps are "Sold here."

Messrs. Marples, Leach & Co., Ltd., Adnil Buildings, London, E.C.—Stock list of A.C. and D.C. motors, with prices of same.

Messrs. Ferranti, Ltd., Hollinwood.—New catalogue (44 pp.) produced in most admirable style, giving descriptions, capital half-tone illustrations, and very clear diagrams of connections, of their various alternating-current meters. Notes on testing, adjusting and installing are given. Some views of different departments at the works appear at the end of the book, with a list of electricity supply authorities to which Ferranti A.C. meters have been supplied.

Messrs. Johnson & Phillips, Ltd., Charlton.—Two new price lists: one dealing with continuous-current motors and starters, and giving prices for protected, ventilated, and enclosed type motors, either series, shunt, or compound wound for 110, 220 and 440 volts, and also prices for the spare parts and armatures, and shipping specification for each size of motor; the other is a price list dealing with the various materials required by electrical contractors and engineers who have to handle cables in the course of their business. Both price lists are coded.

The Campbell Gas Engine Co., Ltd., Halifax.—Two catalogues have recently been published by this company. No. 1, in the course of some 24 pages, gives some faultlessly executed illustrations with tabulated sizes, code words and prices, also descriptions, of their "Campbell" gas engines and suction gas plants, both ordinary and electric lighting types. No. 2 (of 32 pages) describes the general details of construction of the "Campbell" horizontal producer-gas engines, and illustrates all the various parts.

Trade Announcements.—The manufacturing business of the Johnson-Lundell Electric Traction Co., Ltd., and the freehold factory at Southall, fully-equipped with plant, machine tools, patterns, drawings, &c., have been purchased by the J. L. Manufacturing Co., Ltd., who will now continue to manufacture under licence, the patent "Johnson-Lundell" laminated field motors and dynamos, and will carry on a general electrical engineering business.

Mr. T. L. Walker, electrical engineer and contractor, has removed to 216, High Street, Bangor, N.W.

Mr. John T. Mcansh, of Messrs. Hardy & Padmore, Ltd., ironfounders, Worcester, has found it necessary, owing to the development of the firm's business in electrical trade castings, to confine his attention to this department in London. His address is 32, Hornsey Rise Gardens, N.

Mr. G. Braulik has taken large and commodious additional premises at No. 8, Lambeth Hill, E.C., adjoining his present offices and warehouses.

Mr. Jas. E. Lea, of 28, Deansgate, Manchester, announces that from the present month his business will be known as the Lea Recorder Co.

Messrs. Geo. Piggott & Co. have changed their name to the Piggott Electrical Co., and their address to 24, New Bridge Street, E.C. Telephone No., Holborn 2208. They have now opened stores for Turner electrical elevators, and Imperial conduit tubes and fittings, for which they are agents, for the convenience of London clients.

Messrs. Peter Hooker, Ltd., have purchased and taken over from the liquidator of the Newall Engineering Co., Ltd., the entire plant, stocks, patents, and goodwill of that company's business in limit gauges, measuring machines, micrometers, surface plates, and other products, established now for about seven years. They will continue same as a department of their own business under the name of the Newall Engineering Co., at their works, Blackhorse Lane, Walthamstow, London, E.C., as soon as removal from Warrington can be effected. The new factory will probably be equipped and running in about two months, but, to avoid delay in the execution of orders, they will carry on business at the above Warrington address until this time has expired.

Meeting of Creditors.—The Electrical Instrument Manufacturers, Ltd., Freezywater, Waltham Cross, Hertfordshire.—The first meeting of creditors herein was held on the 2nd inst. at the offices of the Official Registrar, 14, Bedford Row, E.C., before Mr. Cecil Mercer, Provisional Liquidator and Official Receiver. Having dealt with the proofs, the chairman said that no statement of affairs had been filed. It seemed, however, from the estimate of one of the officials of the company, that the unsecured creditors amounted to about £1,200, and the assets to £121, but these were covered by debentures. It appeared from the statement that the statutory questions answered by Mr. Thomas Ward, managing director of the company, and lodged on behalf of the company, that the company was formed about the year 1904 with the object of carrying on the business of electric instrument makers, the registered offices of the company being at Freezywater, Waltham Cross. No prospectus was ever issued to the public. The nominal capital of the company was £5,000, divided into £4,000 ordinary shares of £1 each and 100 founders' shares. No capital was offered for further subscription. The vendor of the business to the company was Mr. Thomas Ward, and the amount of the purchase price was £2,000, payable and paid in shares. The property acquired was the lease and goodwill, plant, machinery and utensils. Mr. Ward, it appeared, had previously purchased the property from the Receiver for the debenture-holders of another company. The company had no working capital. About two years ago debentures were issued to the extent of £500 to keep the company going. It was finally agreed to adjourn the meeting to enable a proper statement of affairs to be filed.

LIGHTING and POWER NOTES.

Clayton-le-Moors.—The U.D.C. has passed a resolution assenting to Accrington T.C. applying in its name and on its behalf for a prov. order for E.L.

Cleethorpes.—The U.D.C. has decided to ask the B. of T. to grant an amended E.L. Order in place of the existing one, which expired in October. The Council is prepared to carry out an amended scheme.

Continental Notes.—ITALY.—The authorities of the province of Como have lately granted a concession for a plant to be put down at Miniera to utilise the water power of the river Trallo in the generation of electrical energy for lighting and power purposes.

An application has been made to the authorities of the province of Girgenti for a concession to put down a plant to utilise the water power of the river Sosi-Verdura, at Ribera, in the generation of electrical energy for lighting and power purposes.

NORWAY.—The company which runs the 40,000 H.P. hydro-electric station, near Notodden, for the manufacture of atmospheric nitrogen according to the process of Birkeland and Eyde intends shortly to increase its capacity to 200,000 H.P. The works at present manufacture nitrate for the textile industry, and the enlarged operations have in view the manufacture of nitrates for agricultural purposes and of sulphuric acid. The existing equipment consists of four 10,000-KW. generators, and has given satisfactory results, while the output, notwithstanding the steadily rising production, has been very advantageously disposed of.

In connection with the purchase by the Badische Anilin und Soda Fabrik of the Matre River at the end of the Mas Fjord, between Bergen and the Sogne Fjord, the Bergen journal *Morgenavisen* of September 26th contains an announcement to the effect that a company named the Aktieselskab Matrefaldene, whose objects are stated to include the working of present and future property in Mas Fjord and neighbouring places, including the erection of factories, &c., has applied for registration in the district of Nordhordland. The seat of the company is to be at Matre. The capital of the company, which is understood to practically represent the German firm above referred to, is given as amounting to 10 million kroner (about £556,000) in 1,000 kroner shares. The directors are three Norwegians. In the same connection the *Morgenavisen* adds that the registration is also expected shortly of another company, the Aktieselskab Tyinfaldene with a capital of 12 million kroner (about £667,000), and that one of the three directors of the Aktieselskab Matrefaldene has left Bergen with engineers who have been planning works at the Matre and Tyin Falls, to make arrangements in connection with the properties which have been acquired by the German firm, and for which the latter is reported to have now obtained a concession from the Norwegian Government.—*Board of Trade Journal.*

DENMARK.—The authorities of the Municipal Central Electric Lighting Station in Copenhagen have lately acquired a 5-ton petrol motor tip-wagon which is to be used for the transport of coal from the docks to the generating station.

Coventry.—Sanction has been received from the L.G.B. to the borrowing of £23,828 for mains, transformers, services, motors and meters.

Dudley.—The T.C. has revised the charges for electricity as under:—Shops, 3d. to 3¾d. per unit, according to consumption; private houses, hospitals, hotels and clubs, 2¾d. to 3d.; theatres, 3¼d.; places of worship, 3¾d.; power and heating, 1d. to 1½d.

Greenock.—From the annual report of the Corporation electricity department just issued, it appears that the total length of cables in the burgh is 116 miles. The capital account increased during the year from £122,377 to £149,757. The units sold show an increase of 41 per cent. for private lighting and power, and a decrease of 15 per cent. for traction. The total output was 3,275,018 units. The number of consumers has gone up to 739, while the motors in use equal 4,300 H.P. The gross profit on the year's working was £8,967. The average price for electricity is lower in Greenock than in any other Scottish town.

Liverpool.—The final report of the Corporation's consulting engineer (Mr. A. B. Holmes) on the four Westinghouse turbo-alternators at the Lister Drive power station has been issued, from which it appears that as originally supplied, the two 1,600-KW. machines ordered in May, 1903, and the two 2,000-KW. machines subsequently ordered in December, 1904, did not fulfil the contract conditions as to steam consumption. By arrangement with the makers, however, all the turbines have been partly rebuilt, and the first two alternators modified so as to give the Corporation four similar 2,000-KW. sets, which have subsequently fulfilled the steam consumption guarantees. Mr. Holmes points out that the reconstruction has been carried out under great difficulties, and he does not consider, under the circumstances, that the specified penalties for delay should be enforced.

The Liverpool scale of charges for electrical energy is attracting considerable attention at the present time; it is pointed out that the rate of 2d. per unit for the first 3,000 units, 1½d. per unit for the succeeding 7,000 units, and 1d. per unit for all additional energy, compares unfavourably with the rates of neighbouring towns.

London.—STEPNEY.—The Finance Committee have applied to the L.C.C. for a loan of £7,000, as a supplemental estimate, towards defraying the cost of the erection of the generating station at Blyth's Wharf. As the new station will not be ready to supply energy during the ensuing winter, it has been decided to obtain a supply from "a contiguous undertaking" for a sum of £100, conditionally, the Council to carry out the work of linking up the mains and paying a further sum of ¾d. per unit for each unit actually taken.

LAMBETH.—The B.C. General Purposes Committee objecting to the purchasing powers proposed to be conferred on the L.C.C. by the London Electric Supply Bills on account of its effect on the B.C.'s power of purchase of the South London Electrical Supply Undertaking, has decided to lodge petitions against the Bills.

Rochdale.—The Electricity Committee of the T.C. has decided not to make any alteration in the charges for electricity for lighting, but to allow discounts as under:—Accounts below £5, 2½ per cent.; £5 and below £10, 5 per cent.; £10 and below £20, 7½ per cent.; £20, 10 per cent.

Stockport.—The T.C. has received from the L.G.B. sanction to a loan of £10,500 for electricity purposes.

Stoke-on-Trent.—At a meeting of the B. of G. on October 1st the consulting engineer submitted a report, showing that the cost of producing energy at the Workhouse was 1·63d. per unit.

Tasmania.—The question of extending the Launceston municipal electrical plant is receiving attention, the demands on the present generating station having grown almost beyond its capacity. The city engineer and city electrical engineer have been called on to report on suitable schemes, several of which, both hydro-electrical and steam, have been suggested.

The Council's powers amount to £160,000, and £170,000 has already been spent.

Turton (Lancs.).—The U.D.C. has decided, on the advice of its Parliamentary agents, to apply to the B. of T. for a provisional order for electric lighting.

Wedmore.—The Axbridge R.D.C. has given consent for the erection of overhead wires at Wedmore by the Wedmore E.L. Co., which is establishing electricity works at that place.

Wednesbury.—The Lighting Committee of the Corporation has received from the B. of T. a copy of an award providing that the electric mains of the Midland Electric Corporation for Power Distribution, Ltd., shall be laid under the roadway, and not under the footway. The consent of the Board has been received to the placing by the Corporation of an overhead line for a distance of about 1¼ miles along Trouse Lane and Darlaston Road for the supply of electricity. Notices have been received from the Midland Electric Corporation for Power Distribution, Ltd., of their intention to open certain roads for the purpose of laying electric mains and works in connection therewith.

Wimbledon.—An agreement has been approved between the Corporation and the Foster Arc Lamp and Engineering Co. for a supply of energy to the company's works in Hill Road, at 1¼d. per unit, the minimum consumption to be 20,000 units per annum.

Worthing.—In presenting the half-yearly estimates at the meeting of the T.C. on Monday, Alderman White announced that the electric lighting account was about £215 better than they had expected, and that although they would be paying £350 less for public lighting during the next six months than they paid last winter, it was estimated that the adverse balance would be reduced to about £65 at the end of the half-year.

TRAMWAY and RAILWAY NOTES.

Argentine.—Advices have been received from Buenos Ayres to the effect that it is feared that the Bill for the construction of the underground railways in that city by the Buenos Ayres Rosario and the Buenos Ayres Western Companies will not be passed by Congress, owing to the opposition of the municipality.—*Financial News.*

Belfast.—At the monthly meeting of the Corporation, a long discussion took place as to the state of the permanent way of the tramways, and the big expenditure in upkeep. The cost of upkeep was said to be £133 per mile, where it should only be about £10 per mile. It was stated that last year the outlay on the track was £3,000; this year it would be about £5,000, and probably £10,000 next year.

Blackburn.—It was decided by the T.C. on October 1st that the tramway extensions authorised by the Blackburn Corporation Act, 1908, with one exception, be proceeded with.

Bournemouth.—An animated discussion took place in the T.C. on October 6th on the questions arising out of Major Pringle's recent report to the B. of T. on the fatal accident on May 1st. It was decided by 18 votes to 14 to adopt the Tramways Committee's recommendation that Mr. J. B. Hamilton, general manager of Leeds City Tramways, be appointed to advise as to what alterations, if any, it was necessary for the Council to make in the organisation and working of the tramways system.

Continental Notes.—ITALY (SICILY).—A concession has been granted by the Italian Government to the Società Elettrica della Sicilia Orientale (of Milan) for the appropriation of water from the River Cassibile for a term of 30 years, for the generation of electric power. The objects of the Società are to

supply electric power for private enterprises, and to construct and work electric tramways between Syracuse and some of the towns in that province. The necessary outlay for the purchase of plant and the construction of canals and reservoirs is estimated at two million lire. The work is to be completed by the end of 1909.—*Board of Trade Journal.*

Russia.—A 300-h.p. Diesel engine and generator is being installed at the central station at Ekaterinodar of the Société Generale de Tramways et d'Applications d'Electricite (Russie).

Germany.—The new section of the Elevated and Underground Railway, from the former terminus at the Potsdamer Platz to the centre of the city, was opened on October 1st. The line is in the form of a shallow subway beneath the roadway, and has three stations at busy centres.

The Baden Government is considering the reconstruction of the railway from Karlsruhe to Gottingen; it is proposed to substitute single-phase working with a trolley pressure of 8,000 volts for the present 550-volt direct-current system.

France.—The brakes of an electric car failing on a steep hill at Brest recently, the car jumped the rails and overturned, ten persons being injured.

Darlington.—At a meeting of the T.C. on the 1st inst., the Finance Committee recommended (having regard to the provision of a larger fund for depreciation on the light railways) that from March 31st last, and until the Council should otherwise determine, instead of the interest on loans now outstanding being allowed to decrease £68 each year, that amount be added to the liquidation instalment, and that the total made up of interest and liquidation be maintained at the same figure as it stands at present, viz., £4,355 5s., until the loans are repaid. This will diminish the period of repayment from 40 years to 29 years.

Eastbourne.—On the question of motor-omnibuses, Councillor Neidermayer recently moved an amendment that £250 should be expended in converting one of the petrol 'buses to electric driving, with a view to improving the present service. The motion was lost on the vote.

Glasgow.—The T.C.'s Committee on Tramway Works and Stores has had before it a statement by the general manager as to suggestions in the report by Colonel Yorke, of the Board of Trade, on the tramway accident at High Street in January—when two lives were lost and several persons injured—and has recommended (*a*) that further consideration of the question as to the method of operating the brakes on the cars be continued; and (*b*) that all the cars be fitted with additional devices for sanding the tramway rails as now proposed by the manager.

The T.C.'s Sub-Committee on Tramways Works and Stores has recommended that the Corporation offer £6,000 for the ground adjoining the car depôt at Maryhill, for the purposes of depôt extension.

Isle of Man.—An inquest was recently held in connection with the fatal collision between an electric and a horse car at a level crossing in Ramsey; the evidence exonerated the electric tramway company from blame, but recommended that a flagman should be employed at the crossing.

Leeds.—The construction of the Yeadon and Guiseley tramway is to be proceeded with during the ensuing winter, as well as the extension from Horsforth to Guiseley. The Board of Trade's sanction is sought to the construction of a double line of tramways in Sovereign Street to connect the existing tramways in Neville Street and Briggate.

Liverpool.—On Thursday last week, an experimental service of "first-class" cars was inaugurated on the Garston route for the benefit of those who are prepared to pay double fares. The new service has not escaped criticism, a suggestion being made in some quarters that it was an indication of snobbishness to have a distinction drawn in the classes of tramcars; other citizens hold the reverse view just as strongly, and contend that if they desire to travel at increased rates in Corporation tramcars, they are entitled to claim the facilities. Eight cars, painted light blue and white, and bearing notices above the doorways informing all and sundry that they are special cars, are in use. The seats are upholstered in dark blue plush, the other decorations being of white and gold. Seating accommodation is provided for 58 passengers instead of 64, and in every way an endeavour has been made to satisfy the wealthier travellers' comfort and requirements.

London.—Owing to the fusing of some control switches at the Lot's Road power station, caused by a surge in the h.t. mains, the whole of the railways and tramways supplied from that station were shut down for two hours on Saturday afternoon last. The lines affected were the District Railway, the Piccadilly and Brompton, the Baker Street and Waterloo, and the Hampstead tubes, also the London United Tramways between Tooting, Wimbledon and Kingston. Fortunately, no accident happened, although much inconvenience was caused by trains coming to a standstill in tunnels and by stationary cars on the tramways.

A meeting was recently held at the Westminster Palace Hotel, to discuss an extension of the electric railway from Wimbledon through Merton and Morden to Sutton. Owners of land and others interested in the district through which the railway would run, have been approached and, if thought desirable, Parliamentary powers will be sought. According to the *Daily Telegraph*, a syndicate has been formed to construct a tube from Victoria and Charing Cross to the Crystal Palace *via* Peckham, Forest Hill and Upper Sydenham. It is stated that a Bill will shortly be deposited in Parliament.

An outbreak of fire occurred at the London United Tramways Brentford depôt, on October 2nd, and necessitated the attendance of five fire engines, owing to a quantity of pitch being alight.

A fire broke out on a Metropolitan electric train at Swiss Cottage station, on October 6th. The motor coach was enveloped in flames, which attacked a foot-bridge overhead and the platforms on either side. The fire, which is attributed to a naphtha lamp in the luggage compartment, was quickly subdued by the fire brigade.

The Kensington B.C. has decided to forward to the L.C.C. the report of its Works Committee, opposing the proposal to extend the tramways from Battersea Bridge to Uxbridge Road, *viâ* certain main roads in Kensington.

A number of summonses taken out by the Hammersmith B.C. against the London United Tramways Co. as a test case, were heard at the West London Police Court on the 5th inst. The B.C. claims that the company has not fulfilled its obligations in the matter of road repair. The magistrate decided that he had jurisdiction in the matter, but that a case of such importance ought to be decided in a higher Court; he, therefore, adjourned the summonses *sine die*, for that course to be taken.

L.C.C.—The tramways department has arranged for its employés to have annual holidays without loss of pay. The arrangement provides for annual leave of from six to two days, according to the period of service of the men, and as the leave occurs during the months from October to March, it is expected that the spare men will, to a large extent, find work during the winter months.

The expert opinion, which it was understood would be obtained regarding the working of the Mile End tramways, which are equipped on the "G.B." surface-contact system, appears now to be available, although it has not been made public. It is understood that the President of the Institution of Electrical Engineers has reported on the matter, and indicates what steps are necessary to ensure the efficient working of the line.

The Council is notifying the local authorities concerned that a scheme will shortly be prepared for the electrification, diversion and extension of the Tooley Street to Deptford tramway.

An inquest on Henry Shipp, who died from shock received in the collision between two cars in the City Road on September 20th, resulted in a verdict of accidental death, the jury, however, added that the driver lost his nerve, and, owing to want of judgment, failed to apply the brakes properly.

Rossendale.—Mr. J. K. North, manager, Mr. P. Maling, traffic superintendent, and part of the old company's staff are working the Rossendale Valley tramways for the Rawtenstall Corporation, who took them over on October 1st. The work of erecting tramway poles for overhead equipment for the new electrical system has been commenced in Haslingden New Road by the British Insulated and Helsby Co. The reconstruction of the Bacup Road and Haslingden New Road sections of the tramway will commence in a fortnight.

Rotherham.—The Electric Light and Tramways Committee of the T.C. has resolved that the Wellgate tramway be immediately extended from Mansfield Road as far as the corner of Badsley Moor Lane.

United States.—According to a trans-Atlantic contemporary, the directors of the Illinois Central Railroad Co. resolved last month to have a full investigation made of the question of electrifying their terminals in Chicago. The most able experts in the country are to be secured to pursue this investigation, and to prepare a report. The *Western Electrician* says that the company has been considering the question of electrification at various times for 15 years without taking definite action, except that it is believed that the comparatively new side-entrance suburban passenger cars are so designed that they can be converted into motor-cars at comparatively slight expense. The Illinois Central has eight tracks into its down-town terminal. There are two tracks for suburban-local, and two for suburban-express service, two for passenger trains, and two for freight. In addition, the trains of the "Big Four," the Wisconsin Central, and the Michigan Central, run into Chicago over the tracks of the Illinois Central.

A proposal has been made to construct a circular tunnel railway in Manhattan for dealing with goods traffic, much in the same way as is done in Chicago. If the Public Service Commission agrees, it is understood that a franchise will be applied for.

TELEGRAPH and TELEPHONE NOTES.

Bahamas.—The Colonial Report of the Bahama Islands for the year 1907-8, states that the revenue of the Telegraph Department was £1,248, and the expenditure £545. In the previous year the revenue was £1,258, and the expenditure £552. A total of 3,847 messages passed over the cable, of which 369 were to and from Great Britain. The total number in 1906 was 3,836, and in 1905, 4,419. As regards the telephone service, there are 216 stations now in operation in Nassau and suburbs.

Brazil.—The telegraph system is divided into 18 districts of at least 600 km. of line, each of which is controlled by a chief engineer. The system in 1907 was composed of 29,475 km. of line and 53,602 of wire. If the lines owned by railway companies be included the figures are 66,264 km. of line and 134,701 of wire.

There were 513 stations belonging to the Government, and including railway stations the number was about 2,000. The Government has concluded arrangements with the railway companies for united working. The rights of foreign companies are limited to cable stations, of which there are nine, and to stations along the Amazon River, making a total of 17 stations. All important centres are telegraphically connected. The Federal Government is undertaking the work of connecting the Amazon territory telegraphically with the southern territory, but owing to the nature of the ground to be traversed the work will take a long time. The length of the line will be about 2,000 km. The total telegraphic business of the country amounts to about 4,500,000 telegrams, containing 67,500,000 words. In Brazil the telegraphic system is not regarded as a source of revenue to the Treasury, the main object of the Government being to facilitate as much as possible the use of the telegraphs, and to connect all the most distant parts of the Republic. Baudot instruments are being largely introduced, and are already in use between Rio and St. Paul, Bahia and Pernambuco, as well as between Rio and Rio Grand do Sul and other places.—*Journal Télégraphique.*

New Telegraph Offices.—A new telegraph office has been opened in German South-West Africa at Bethonien, while the Great Northern Telegraph Co. announces the opening of new offices by the Chinese Administration at Taihu, Paoying, Ningyuan, Tenghwangcheng, Haicheng, Takushan, Tatungkow, and the office at Antung has been re-opened.

Post Office Telegraphs.—There was a decrease of 3·9 per cent. (not an increase, as stated in our last issue) in the number of inland telegrams transmitted last year; the fall was mainly noticeable in London, and is to be attributed to the increasing popularity of the telephone. The number of foreign telegrams dealt with, excluding telegrams handled entirely by cable companies, was 9,147,000, practically the same as in the previous year. During the year 39 licences were issued for wireless telegraph installations, of which 37 were experimental, and two for private purposes; the number of installations covered was 58. The number of telephone trunk offices open was 551, compared with 533; 342 new circuits were opened, raising the total to 2,385 circuits, and 80,000 miles of double wire. The capital expenditure on the trunk system during the year was £570,406, bringing the total up to £3,946,658

Railway Telegraphists.—Notice has been given of reduction of wages to all men employed in the Telegraph Section of the Electrical Engineers' Department of the Great Eastern Railway system, as from January 1st next. This is in reply to a demand for an increase, put forward in May last.

Telegraphic Interruptions and Repairs:—

	Cables.	Interrupted.	Repaired.
Port Arthur-Chifu	.. ..	Mar. 9, 1904 ..	..
Assab-Massouah ..	.. ..	June 28, 1908 ..	..
Sitia-Rhodes ..	.. ..	Sept. 20, 1908 ..	..

Telephone Agreements.—Last week the Postmaster-General sued Mr. J. Wertheim for £6 13s. 11d., for the use of the telephone service for one year. The Assistant Registrar found for the plaintiff, but defendant's solicitor applied for a new trial. The defendant was a director of the Fan Publicity Co., Ltd., which took over the telephone from him, and had paid for it subsequently, but the Postmaster-General sued for the use of the telephone during a prior period. Judge Lumley Smith ruled that the defendant had not obtained his release from the agreement, and must pay the amount, with costs, the application for a new trial being refused.

Wireless Telegraphy.—The *Journal Télégraphique* states that Dr. Gustav Schneeli, Berlin, has issued a book dealing with wireless telegraphy and international rights, which the journal recommends all those who study international law, and are connected with cable and landline and wireless telegraphy, to read. The journal states that already many questions of international law have arisen in connection with radio-telegraphy in times of peace and of war. In the first chapters of his book the author criticises the opinions already given by various authorities, explains the judicial aspect of the radio-telegraphic convention of Berlin, 1906, and deals with the question of the proprietorship of the air. He maintains that a State has sovereign rights in the air over its own lands. By virtue of this right, resulting from the rights of preservation and defence, a State has the power to control not only radio-telegraphic waves emanating from stations on its own territory, but also from those on foreign territory, and this right also extends to the air over territorial waters. The Doctor deals with all questions which may arise in times of peace and war, and deals with experiences during the Russo-Japanese war. Other subjects dealt with are: Control, restriction and stopping of a wireless service, worked by a hostile or neutral party; apparatus as contraband of war; regulation of service in places occupied by a belligerent; censorship applied by belligerents or neutrals; involuntary interference with international service by reason of the use of wireless by a belligerent. The book can be obtained from Franz Vahlen, W9 Luikstrasse 16, Berlin.

The Post Office Circular announces that the wireless telegraph stations at Heysham Harbour and at Liverpool are open night and day throughout the year, while the station at Parkeston Quay, Harwich, is open always excepting between 12 noon and 6 p.m. on Sundays.

The battleship *Hibernia* left Devonport last week, with new circuits, fittings and instruments, to join the Channel Fleet in a cruise, during which it will carry out a series of experimental trials with the apparatus now supplied to ships of this class.

Mr. Marconi is reported to have said that the work of duplicating he plant at Glace Bay and installing more powerful apparatus will be finished in three months, and that an overland wireless system across Canada will be installed.

An agreement has been concluded between the Aberdeen Town Council and the Admiralty with regard to a new wireless telegraph station at Stoneywood, for a period of five years.

Wireless Telephony.—Experiments have been carried on recently at Portsmouth by Dr. Lee de Forest, in conjunction with the Admiralty, in telephonic communication between warships, and it is reported that successful results have been obtained over a distance of 50 miles.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Adelaide.—November 20th. The City Council requires tenders for the supply and erection, complete, of a refuse destructor, electric lighting plant for the same, &c. Particulars may be obtained from the Agent-General for South Australia, 1, Crosby Square, Bishopsgate Street Within, E.C.

Melbourne.—The Postmaster-General of the Commonwealth requires tenders for the supply and erection of installations for wireless telegraphy at the following places:—Launceston; King Island (Bass Straits); Flinders Island (Furneaux group); Melbourne. See "Official Notices" September 18th.

Tasmania.—March 15th, 1909. Postmaster-General. Telephone switchboard, common-battery system and apparatus for use at subscribers' premises, Launceston. Specifications and particulars of general conditions can be inspected at the offices of the Electrical Review.

Melbourne.—October 20th. 60 D.C. flame arc lamps for the Council. See "Official Notices" October 2nd.

Belgium.—October 14th. Galvanised-iron wire, copper wire, cables, rods, screws, ironwork, iron bolts, porcelain insulators, &c., for the use of the Belgian Telegraph Administration. The conditions, &c., may be obtained at the Bureau des Adjudications, Rue des Augustins 15, Brussels.—*Board of Trade Journal.*

Bury.—October 23rd. Electric lighting of the East Ward Council School for the Corporation. See "Official Notices" to-day.

Cape Colony.—November 18th. Dry cells in quantities from July 1st, 1909, to June 30th, 1910, for the Government. Information from Controller of Stores, G.P.O., Cape Town, to whom six sample cells should be sent. All tenders must be on printed forms supplied for the purpose. A fuller notice appeared in the *Board of Trade Journal* last week.

Carlisle.—October 14th. Coal elevator, conveyor and bunker at the Corporation electricity works. See "Official Notices" to-day.

Chile.—San Eugenio.—November 2nd. Tenders are invited for the building and equipment of an electric central station in this city. Address, Direccion Jeneral de los Ferrocariles del Estado. The State Railway likewise contemplates laying down three 300-KW. generators at Santiago. Particulars from the Oficina Tecnica of the railway.

Constantinople.—The Post and Telegraph Department requires tenders for 8,500 miles 4-mm. steel wire, 15,000 Leclanché insulators, and 1,360 other insulators. A deposit of 10 per cent. is to be made by a local agent.

Egypt.—October 29th. The Ministry of the Interior wants tenders for the installation of electric lighting in the town of Zagazig, in accordance with specifications and plans that may be inspected at the offices of the above Ministry at Cairo.

France.—Paris.—October 13th. Multiple switchboard for the central exchange, Paris. Apply to the Sous-Secretariat d'Etat des Postes et des Télégraphes, Rue de Grenelle, 103, Paris, before October 3rd.

Germany.—Cologne.—The municipality is about to invite tenders for the supply of four 3,000-H.P. turbines for the electricity works.

Hirschberg.—Tenders are about to be invited for the installation of electricity at the municipal high school for girls, at a cost of 380,000 marks.

The municipal authorities of Bielingen, Baden, are about to invite tenders for the establishment of an electric power generating station in the town.

Glasgow.—Relaying of cable at Ruchill Fever Hospital. City Electrical Engineer.

G.W. Railway.—October 20th and November 10th. Stores for the G.W. Railway. See "Official Notices" October 2nd.

(*Continued on page* 607.)

The Exhibition Opening.

We can hardly conceive of there being present in the Rusholme Buildings on Saturday last an electrical engineer with "soul so dead" that he failed to catch the Exhibition spirit. The activity and earnestness of exhibitors and their assistants, the energetic restlessness of the management in their efforts to see that everything was in proper order, and the general readiness, expectation and hopefulness that seemed to possess everybody, augured well for a most successful run. Before we say a word more concerning the show itself, we hasten to congratulate everybody who has contributed to the successful issue that has followed their labours of the last few months. It is, beyond cavil, a fine exhibition, and reflects great credit upon the organisers and business managers, the Committee and consulting engineers, the praise of everybody being especially given to Mr. S. L. Pearce, the city electrical engineer of Manchester, for the manner in which he has devoted himself unsparingly both night and day to the very important duties that have fallen to his lot.

Praise to Exhibitors.

But we feel that, apart altogether from what they will gain as the trade result of their enterprise, there is also a meed of praise to be given to the exhibitors for the advanced state of their displays when the doors were thrown open on Saturday morning. Here and there, perhaps, the lily required some painting, and a number of the stands were not quite finished, but such work as remained to be done was accomplished by the evening, when, with the electric lights ablaze throughout the building, there was quite a brave show. In our opinion, the inside of the hall was as complete as at any important trade exhibition that we have ever visited on the opening day—perhaps excepting the Machinery Hall of the great International Exhibition held at Glasgow in 1901. It may be we are writing with too distinct and painful a recollection of the chaotic state of the exhibits in the Franco-British Machinery Hall on that memorable opening day last May, and, indeed, for some weeks after. Manchester exhibitors for the most part show evidence on their stands of having thrown their whole soul into the work of preparation. If they and their staffs had not "kept at it" during the whole of the preceding night, as we urged them to do in our "Advice to Exhibitors" last week, the result would not have been nearly so satisfactory.

Who was There.

We were going to remark that all the electrical world was there, but that is the sort of thing that one impulsively lets slip when one meets in the course of an hour more electrical men of standing than one rubs shoulders with in three months in the ordinary course. At every turn one seemed to fall across principals and other prominent men connected with electrical industry who were doing something or other to make the show a success, and by ensuring that result were doing the very best thing in the world to make their own effort a profitable investment to themselves.

The Press Luncheon.

Generally speaking, Saturday was not, in reality, the opening day, for it was on Monday that the formal opening ceremony took place. However, when we remark that on Saturday the Exhibition was patronised by about 10,000 people, it will be seen that already it had become a popular feature in Manchester. The Press luncheon, at which a number of exhibitors were present, was the only function on that day, and thereat the toast of "The Press" was proposed in felicitous terms by Mr. W. Davenport, the Secretary to the Exhibition, responses being made by the representatives of the *Morning Post*, and the *Manchester Guardian and Courier*, on behalf of the newspaper Press, and by Mr. H. Alabaster, of the Electrical Review, for the technical Press.

Who Will Go?

We believe that after a few days the Exhibition will be the talk of the district. When the 10,000 of Saturday converse in their offices, their factories, and "over the garden wall" about the fine collection of electrical machinery and material that is to be seen, and about the sweet music of the band of the Coldstream Guards, the Exhibition will be advertising itself in a very profitable fashion, for the district is one abounding in industrial opportunities wherein the applications of machinery are most numerous, and one in which, therefore, little effort would be required to arouse an interest in the largest purely electrical engineering and trade exhibition that has ever been held in the United Kingdom. We shall not be surprised if, especially on Saturdays, the gangways become well nigh impassable because of the throngs of visitors who will desire to take advantage of an unparalleled opportunity for their electrical interest and education. Invitations to desirable visitors have been issued with a liberal hand by some of the local authorities.

What the Exhibition will do.

It is our belief that the interest which this Exhibition is exciting and the publicity that electricity and its applications will receive in a district abounding in possibilities, as well as the awakening that it must inevitably cause among electrical men throughout the country, will give an impetus to the British electrical industry. A great advance may not come all at once owing to the labour troubles and the languishing state of trade generally in the neighbourhood, but the former struggle can hardly last long, and the latter is a position of things which in some respects helps rather than hinders the introduction of electrical applications.

To Our Younger Readers.

In all our consideration of the future of the electrical industry, we must not overlook the important part that the student, the station and charge engineer, the electrical salesman, the wireman-who-will-become-contractor, will have to play therein. In concluding our notes this week, we would urge all who belong to these classes to endeavour between now and the 31st inst., making reasonable sacrifice if necessary, to put in a day at the Exhibition. They will find that it gives an incentive to them in their own calling, it will fill them with greater hope for the future of things electrical, it will impart to them a thousand useful ideas, for they will see things as they are instead of merely reading of them, and it will send them back to their duties with a desire to contribute faithfully their own individual share towards securing a sounder and more progressive electrical industry.

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ELECTRIC MOTORS AND ELECTRIC DRIVING IN FACTORIES.

By FRANK BROADBENT, M.I.E.E.

[NOTE.—The advantages of electric driving have been so often described that it might be thought that nothing new could be said on the subject. In the following article, however, Mr. Broadbent, who is one of our leading specialists in electrical power applications, gives from his own personal experience actual instances which emphasise in a very marked way some of the unique advantages which the electric motor possesses—advantages which are, perhaps, a little apt to be lost sight of in considering the economical side of the question only.—EDS. E.R.]

ELECTRIC motors are now used for almost every conceivable purpose, and it would be difficult, if not impossible, to name any single machine or process where power is needed to which the electric motor could not be applied with advantage.

The rapid spread of electric driving, which has been very largely influenced by the development of electric power supply, has had a very marked influence on the cost of motors. The days have gone by when motors were made in twos and threes, or when they were made to decimal of a horse-power in order to give the precise power required by a particular machine. Powers, speeds and details of construction have now become so standardised that the cost of manufacture has been reduced, to such an extent, notwithstanding the increased price of raw materials, that motors, say, of 7 or 10 H.P., which are very common sizes, can now be bought for 25 to 50 per cent. below the prices of even five years ago. If we compare the prices of larger motors, the differences are even more marked, and motors for moderate powers can now be obtained from first-class makers at about half the prices which were asked 10 years ago.

This reduction in the cost price of motors, coupled with the low rates at which a supply of electric energy is now obtainable, has placed the economy of electric driving, as compared with other methods, beyond all question. True, we still hear occasionally of the economical advantages of driving by suction gas engine power, but the public have apparently discovered that the cost of the coal consumed in the gas producer is not the only item of cost to be considered.

Many as are the advantages of electric driving over either gas engines or other prime movers, there are some points of advantage which are, perhaps, not quite so fully recognised as they might be. An interesting case recently put before me by a client may serve as an illustration of this. It appears that a gas engine of 20 B.H.P. continuous rating had been installed to drive six machines of a special kind. I was called in to explain how it was that this gas engine would not drive more than four of the machines, and even these had to be put on very carefully one after the other to allow the engine time to adjust itself to the load, whereas an electric motor of the same rating—namely, 20 H.P.—was satisfactorily driving six identical machines which were thrown on and off as required. On the face of things, it appeared as though some factor in the conditions had not been stated; but, on making a personal examination of the two works, I was convinced that the 20-B.H.P. gas engine would not do, and could not be made to do, the same work as a 20-H.P. electric motor under the conditions obtaining in these works. As the case is somewhat interesting, it will be as well to give the explanation.

The machines in question are rather stiff for a few minutes after starting, and when under way they take a steady power, that is to say, there is a constant drag with little or no fluctuation, and no give and take as is the case with many classes of machines. The effect of this is that in starting up a new machine, the gas engine is slightly overloaded. As this overload may last for a few minutes, the small amount of energy stored in the fly-wheel is used up, and in a few revolutions the engine commences to slow down. Now, once a gas engine begins to slow down, it will come to a standstill unless the load is quickly reduced. This is what frequently happens. Anyone who has any factory experience at all knows what it means for an engine to come to a standstill with all the belts on the fast pulleys. It involves pulling the shaft round by hand in order to shift the belts; then the engine must be restarted, and the machines put on gradually one by one, the operation resulting in a considerable loss of time and output.

Now, an electric motor, on the other hand, is capable of standing a considerable overload for a short time. It does not depend on an explosion every two revolutions, but on a steady and continuous pull on the armature, the pull varying automatically with the load. A modern motor with commutating poles will take as much as 100 per cent. overload intermittently, and from 25 to 50 per cent. overload for a sufficient time to permit of any heavy machine being started up. This is really the only explanation of the case stated above.

The gas-engine makers suggest putting in an engine of double the power, but I hope to be able to record the fact shortly that a 20-H.P. motor has displaced the gas engine, and is satisfactorily dealing with the work.

It is important to note that in cases of this kind, gas engines must have an ample margin of power to cope with the excess loads due to the starting of individual machines. They are, therefore, working normally far below their rated output, and the consumption of gas per horse-power-hour when running on the normal load is a very different thing from the figure given by the makers, who, of course, give the figures for full load under test conditions. An electric motor is generally run well up to its rated power, and, therefore, at its highest efficiency.

Another of the insufficiently recognised advantages of the electric motor drive, and a very important advantage too, is that not only can the power absorbed by any shaft or machine be very accurately measured, but that irregularities in the drive can be easily detected, and the cause ascertained. The performance of a machine may, in consequence, often be considerably improved. The following instance may serve to emphasise this point.

In connection with a large printing works, electrically equipped under my supervision, there was one machine which the works' engineer considered would require at least 5 H.P. My estimate of the power was about 2½ to 3 H.P. This the engineer considered to be quite inadequate, basing his opinion on the fact that the driving belt was continually breaking, and the machine itself was constantly under repair. However I specified a 3-H.P. motor for the work, and, owing to the slow speed of the machine and small size of the pulleys, a comparatively slow-speed motor was necessary in order to get a direct belt drive. On starting up the machine it was found that the power fluctuated very considerably, varying from nothing to over 5 H.P. in every cycle, that is to say, about 20 times a minute.

Now it had been impossible to detect this previously by the ordinary method of driving from the line shaft, but the electric motor at once showed by means of the power gauge that the cause of the trouble, viz., the breaking of the belts, &c., was due to the fact that the machine was not properly balanced. Owing to its special construction, the machine did not lend itself very well to the addition of balance weights, so I arranged to substitute for the small driving pulley a heavy pulley of about three times the diameter, and exchanged the motor for one running at a faster speed, and having, therefore, more fly-wheel effect. This eliminated the whole of the troubles, and the power, as shown on the gauge, is now practically steady at 2½ H.P. There has been no trouble since, due to the breaking of belts or gearing; in fact, from being one of the worst and most troublesome machines in the place, it is now considered one of the best. Instances of this kind could be multiplied, but this one is sufficient to emphasise one of the unique advantages possessed by the electric motor. Not only does the motor show when a machine is out of balance or out of truth, or otherwise out of tune, but the seat of the trouble may be located with exactitude, and the location of the trouble is a great step towards a remedy.

Another advantage, which is very closely allied to the foregoing and has been already mentioned, is that the power taken by a machine or shaft can be so readily and so exactly measured. After a shaft has once been erected and found to run freely, it is often taken for granted that it will continue to run truly for an indefinite time and to take no more power than when originally installed. This, of course, is not the case, the power gradually rising as the bearings become worn and out of alignment. This gradual increase of power creeps up imperceptibly until at length the engine shows signs of being overloaded. A common remedy is to bore out the cylinder if possible, in order to increase the engine power; or to add an auxiliary engine to relieve it of part of the work. All the time coal is being consumed to wear the bearings away more rapidly. By means of the electric drive this gradual increase can be readily detected and the cause ascertained and removed.

The ease with which electric power can be measured tends also to economy in the use of power. It is, perhaps, not sufficiently realised what a difference there may be between the power taken by two similar lengths of shafting, owing to the different nature of the bearings and the way in which the shafting is erected and aligned. Thus, a piece of shafting running in old-fashioned short bearings, supported by light springy hangers or slings, will take considerably more power than a similar shaft running in self-lubricating, self-aligning bearings having ample length of bearing surface, and supported on substantial stiff hangers or brackets. All points of this nature should be carefully considered in designing any electrical power transmission system, because the additional outlay involved in putting up a really first-class and sound job is very soon repaid by the reduced running cost.

Suppose, for instance, that a shaft put up with a view to cheapness takes 2 H.P. to drive it light, whereas, with a little additional outlay in bearings, hangers, &c., 1 H.P. would have been enough; we are wasting 1 H.P. during the whole time the shafting is running. If we reckon this at 1d. per H.P.-hour, the cost of energy for running the more expensive shaft is £10 per annum less than the cost of energy taken by the shaft put up with a view to economy in first cost. This is equivalent at 5 per cent. to a capital outlay of £200, which represents the additional amount which might have been profitably expended in order to secure a first-class job instead of an indifferent one. But £200 would more than suffice for the whole of the shafting and accessories involved, and the difference between a first-rate and a second-rate job would probably not exceed £30 or £40. Clearly, therefore, whilst apparently £30 or £40 has been saved in first cost, we are actually paying annually for energy a sum which represents the interest on an additional capital expenditure of £200. May I repeat, then, that one of the important advantages of electrical driving is that it tends towards better mechanical work and economy in the use of power, due to the fact that the power consumed by any piece of shafting or machinery can be so easily and so accurately measured, and the effects of improvements made with a view to reducing friction and ensuring smooth and easy running are so easily observed.

Whilst printers were among the first to recognise the many advantages of electric driving, cotton spinners and other textile manufacturers must be reckoned among the last. The reasons for this are very easily understood. In the one case, we have a number of small machines working very intermittently, involving a large amount of shafting and belting running idly for a very considerable proportion of the total factory hours; whereas, on the other hand, we have in cotton factories much larger units of machinery to deal with, and a much more uniform load on the engines.

Another factor is that in cotton spinning one of the chief considerations is perfect regularity of driving, and the mill engine has been brought to such a pitch of perfection that cotton spinners are loath to admit that the electric motor can equal or even approach it. But the actual fact is that with electric driving a very much more constant speed can be maintained on the line shafts than is possible with the most perfect system of mechanical driving from the mill engine. An absolutely constant speed on the engine shaft does not mean a constant speed on the line shafts in the spinning rooms, carding rooms, &c. Careful tests have been carried out which show that in textile factories there is frequently a speed variation of fully 20 per cent. on the countershafts, while the variation at the engine shaft does not exceed 3 per cent. The explanation is that the power taken by the individual machines is a very variable quantity, but these individual variations level themselves up so that the power on the engine shaft is fairly constant, and the governing is, therefore, very close. Owing to the various stages of power transmission between the engine and the line shaft there is scope for considerable belt slip to take place, and the squeak of the belts, which is a characteristic feature of all textile factories, is audible evidence of the enormous amount of slipping which does actually take place. This belt slip means not only speed variation, but also considerable loss of energy. By means of electric driving, the power is brought as closely to the point of application as possible, all intermediate transmission arrangements such as belts, shafts, bearings, &c., being eliminated. By this means the 20 per cent. speed variation referred to above can be quite easily brought down to about 3 per cent. on the line shaft. I am here referring to shafts driving machinery such as looms and mules, which take a very variable power. In the case of carding machines, the power demand is much more uniform, and the variation of speed in the ordinary mechanical systems of driving may be anything between 5 and 10 per cent., a variation which could be reduced by the electric drive to 1 per cent. or even less.

A very important feature, and one which may have far-reaching results, has been brought to light by the agency of the electric motor drive, viz., that the constant speed which has always been aimed at in cotton spinning does not give the best results nor the maximum output. It has been shown that whilst the acceleration of the spindles from rest should be as smooth as possible—that is to say, free from jerks or sudden change of speed—the maximum speed might be gradually raised to 10 or 15 per cent. above that at which the spindles are at present usually run. Thus, by starting the machines rather slower than the normal rate, and gradually raising them to a maximum speed, the average speed can be considerably raised above that which is found to be the limit with the ordinary mechanical system of driving. By means of the individual electric drive, the speed of the spindles can be automatically varied to meet this condition in a manner which is quite impossible with the mechanical methods at present in vogue. The lower initial speed and the gradual acceleration result in fewer breakages than occur with the present method of constant speed driving; and the increased speed results in a more compact winding on the spindles. Obviously, such a method means a considerable increase in the output and a better quality of work. It has been estimated that the ordinary electric drive, that is, the electric drive which gives a constant speed, means an increased output of fully 10 per cent. above the steam-engine drive, and if it proves that higher speeds can be run owing to the extreme regularity of the electric drive, the increased output will be even more than this. The economical effect of increased output may be more important than economy in the cost of power; in fact, it is claimed that for a given number of spindles an increase of 10 per cent. in the output would be more than sufficient to pay the whole cost of the electrical energy required to drive the factory.

Electric Lamp Exhibits. — Although the articles appearing in the following pages deal almost entirely with motor and power plant and apparatus, it must not be imagined that the electric lighting material exhibited is unimportant. Most of the lamp manufacturers are strongly in evidence. Osram metal lamps are effectively festooned and otherwise displayed on what is the biggest show in the building, and elsewhere a number of Robertson girls are engaged in the various processes of lamp-making. By the way, we understand that in spite of the big demand that has arisen for Osrams and other "wire" lamps, the "consumption" of Robertsons is as large as ever. Where do they all go? There are also Gilbert, Westinghouse, G.E.C. and Oliver arc lamps, Cooper-Hewitt mercury-vapour lamps, tantalum, Westinghouse tungsten lamps, and Sunbeams of new and old types, but our notices of these will appear in our next and succeeding issues.

MOTORS and MOTOR-DRIVEN EXHIBITS.

[In these pages are given Descriptions of Electric Motors and their Applications, also Apparatus Employed in connection therewith, which are now on Exhibition. This Section will be concluded in a later Supplement to appear before the close of the Exhibition. The No. of the Stands are given in the headings.]

The Union Electric Co., Ltd. (175, 231).

The Union Co.'s exhibit covers a wide range of electrical plant, including motors, arc lamps, instruments, switchgear, &c.

As regards the motors, the most prominent exhibit is a 440-volt 110-H.P. machine, arranged for running at 150 R.P.M. This machine is of the latest type, with end shields and reversing poles, the two shields carrying the pulley end and commutator end bearings respectively.

Special attention has been paid to lubrication in these machines, with a view to securing efficient construction and working. Numerous other direct-current machines with outputs from 30 H.P. down to a fraction of a H.P. are on view, the larger sizes being of the end shield type, and the smaller, totally enclosed and designed for operating signs and similar light work.

UNION MOTOR DRIVING THREE-THROW PUMP.

A variety of three-phase machines of the slip-ring and squirrel-cage types are shown, and various motor-starting gears coupled to the machines, and suitable for the varying conditions under which the motors are employed.

In addition to the above, several examples of electrically-driven plant are included, these comprising a triple-cylinder pressure pump by R. Warner & Co., shown in combination with an automatic tank starter of the Fortiter design; a centrifugal pump and motor with Fortiter speed regulator; a small paraffin engine and generator set for house lighting purposes, &c. We shall refer in a later issue to other sections of the company's exhibit.

Messrs. Bateman's Machine Tool Co., Ltd. (90, 91).

Engineer visitors at the Olympia Exhibition in 1906 will recognise on Messrs. Bateman's stand an old acquaintance, in their electrically-driven "Top-speed" planer. The machine on view has a cutting speed up to 80 ft. per min. and a return speed of 170 ft. per min. It is electrically driven by a motor mounted on the housing, and is classed as a 36 in. × 36 in. × 10 ft. machine, requiring some 10 H.P. to drive it.

The machine acts on the buffer principle which has recently become popular; compression springs are fitted under the table at both ends, which assist in bringing the table to rest and restarting it, at each end of the travel.

This prompt reversal without shock, &c., enables the table to run at high speeds without risk of damage.

Messrs. Bateman have considerable evidence of the utility of these machines in practice, if only from the fact that day and night work has been necessary in order to meet the requirements of the trade.

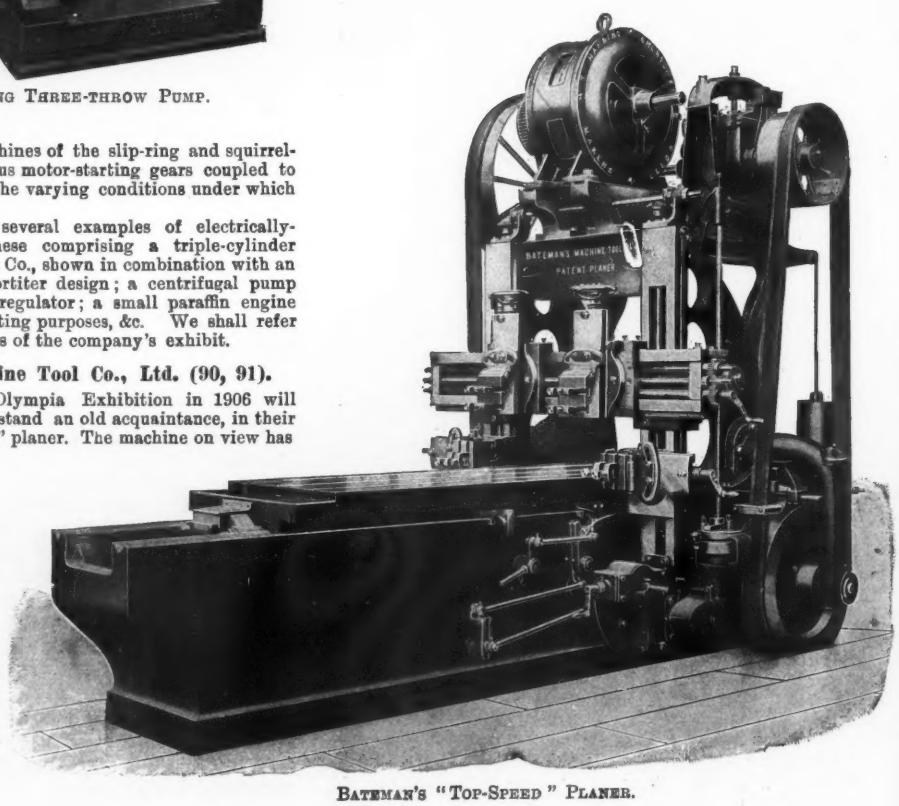
Messrs. Ludw. Loewe & Co., Ltd. (54).

A special display of the well-known D. W. F. patent ball-bearings, for which Messrs. Ludw. Loewe are sole agents, will be found on their stand, together with a selection of small tools, gauges, cast-iron resistance grids, Veeder precision die castings, &c. The

D. W. F. JOURNAL BALL BEARINGS, COMPLETE.

patent standard ball-bearings from 18 in. diameter downwards, together with the pyramid of balls ranging from 4 in. diameter downwards, bring vividly before one the extensive use to which this class of bearing is now put.

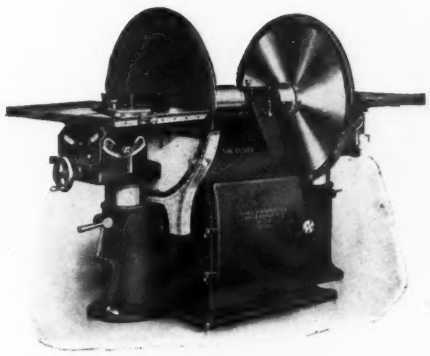
Indeed, reference need only be made to the numerous photographic views shown on the stand, to realise many of these applications.



BATEMAN'S "TOP-SPEED" PLANER.

The Oliver Machinery Co., Ltd. (283).

Messrs. Oliver's special tool exhibit is "special" in more ways than one. In addition to the attractive feature of the tools themselves—they are specially adapted for pattern-shop use—is the fact that they are all electrically driven. One of the most imposing of these tools is a wood grinder carrying two 36-in. disks, and complete with piping, fan, exhaust pipes and settling chamber.

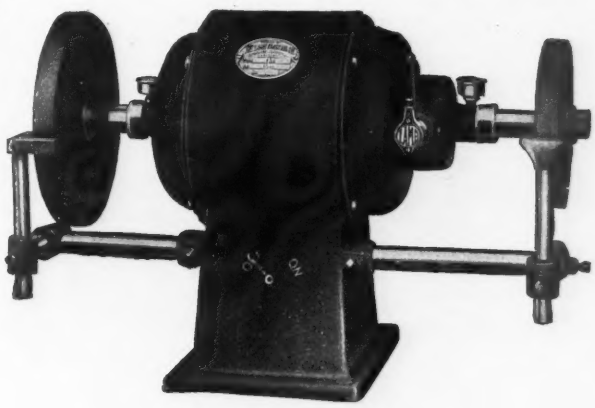


Oliver Universal Saw Bench.

An Oliver universal saw bench and an Oliver band saw are also prominent tools driven by independent motors; and not the least interesting section in these days of scientific tool adjustment, is the display of Oliver grinding machinery.

objectionable features, as will be gathered from the illustration we give of it.

A specially light motor, giving ¼ H.P., is also worthy of notice,



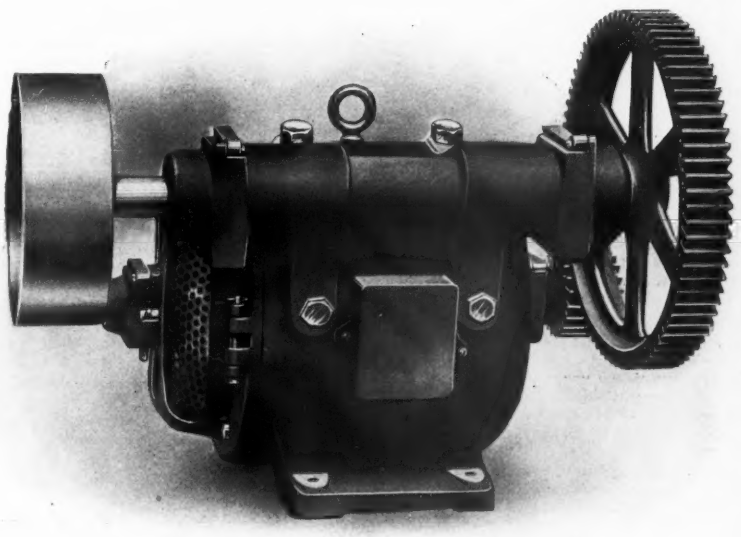
Oliver Electrical Grinder.

and should find employment in many places where minimum weight is desirable.

Possibly the most interesting feature of the stand is the motor-generator illustrated below, in which the motor takes current from the mains at 200 volts pressure, while the dynamo generates at 25 volts pressure, and supplies a number of 16-C.P. metallic-filament lamps.

By means of a change-over switch, the current from the mains is first used to light a number of 200-volt 16-C.P. carbon filament lamps, its amount being measured by an ammeter. The switch is then changed over to the motor, and with the same current passing through the ammeter, the large increase in the light is very noticeable. The introduction of these motor-generators on the supply mains of direct-current networks, in the same manner as auto-transformers are made use of by many alternating-current supplies, seems a proposition well worth considering in many cases. These machines are made in all sizes from ¼ to 250 H.P., and are claimed to embody the advantages of the inter-polar type without their drawbacks; owing to the simplicity of construction, due to the "Zone" winding, they are specially adapted for use in situations where they have to run for long periods without attention, or where only unskilled labour is available.

A special advantage claimed for them is the low temperature rise, due largely to the ample ventilation provided; sparkless commutation is obtained at all loads with fixed brush position. All parts are made interchangeable, and the bearings are of ample dimensions, with ring lubrication.

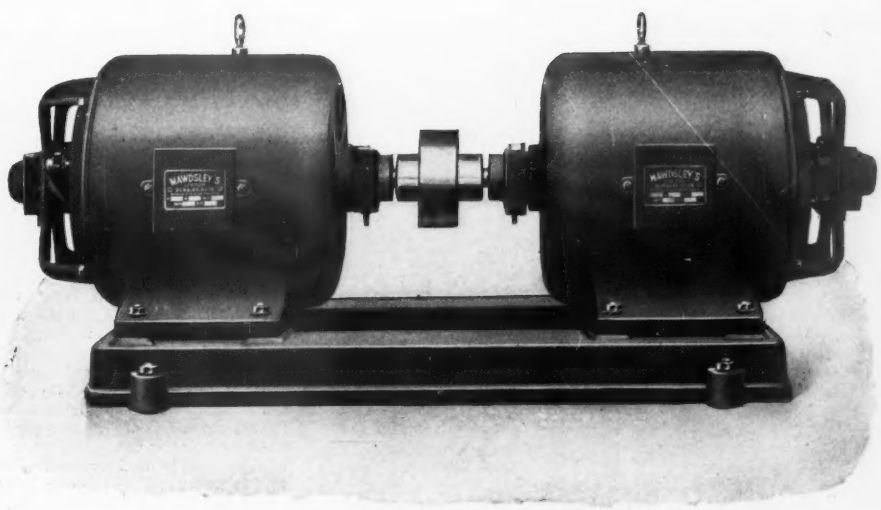


Mawdsley Zone Geared Motor.

Messrs. Mawdsleys, Ltd. (284a).

Several different types of the well-known patent "Mawdsley Zone" dynamos and motors are shown by this firm. Among their exhibits are motors for crane and lift work, one of the former being shown under load of 6 H.P. produced by a "Wellman" brake, and operated by a "Dinkey" controller, whilst a lift motor, also under brake load, similarly produced, has its movements controlled by an M.S. controller, so that intending purchasers can see them as nearly under actual and practical conditions as is possible in an exhibition.

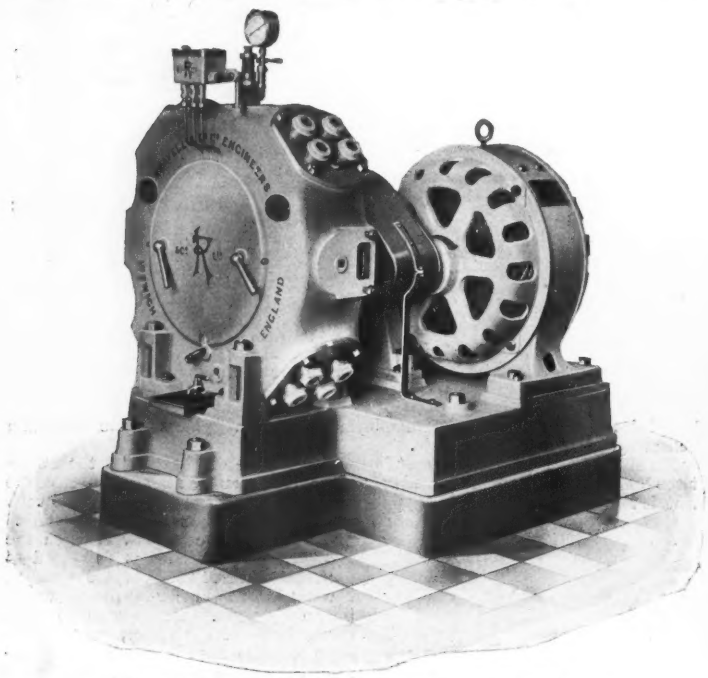
A geared motor presents features of interest, the gearing being well and compactly designed, and being free from many



Mawdsley Zone 200/25-volt Motor-Generator.

Messrs. Reavell & Co., Ltd.

On Messrs. Reavell's stand there are shown one of their patent Quadruplex air compressors, and their new type patent sub-station air compressor. The former, which we illustrate, is of the S7 water-jacketed type, and runs at a speed of 250 B.P.M.; the free air capacity is 20 cb. ft. per minute, with a volume swept of 144 cb. ft., and when working at 100 lb. pressure per sq. in. the set would require



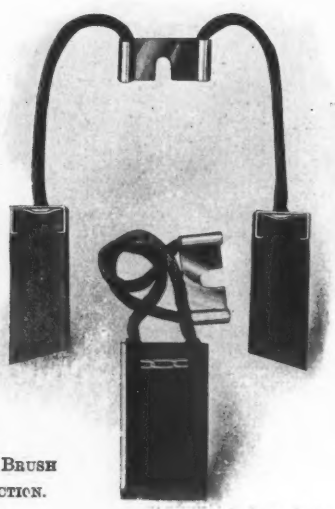
REAVELL QUADRUPLEX AIR COMPRESSOR, AND UNION MOTOR.

27 B.H.P. at the compressor crankshaft. The compressor is driven by a 440-volt D.C. enclosed ventilated motor supplied by the Union Electric Co., Ltd., through a raw-hide pinion and cast-iron spur wheel made by Messrs. David Brown & Sons, of Huddersfield. The motor runs at 750 B.P.M. The whole is carried on a common bedplate, and when used for mining purposes it can be mounted on wheels.

The sub-station air compressor, which is intended for blowing the dust out of armatures, &c., is driven by a motor wound for 440 volts. A special feature of the set is the ingenious method of obtaining reciprocating motion from the motor spindle, which has been invented by the makers, the compressor being thus directly driven by the motor. The compressor has a capacity of about 10 cb. ft. per minute, and is provided with a starting switch, 30 ft. of flexible with wall plug, and 15 ft. of hose fitted with a nozzle, all neatly carried on a drum on the top of the motor. The machine is either fitted with handles (it can be carried by two men) or mounted on three rubber-tired wheels. It has already been illustrated in our pages.

The Morgan Crucible Co., Ltd. (177).

This company are showing a comprehensive selection of their now well-known Morganite and Battersea carbon brushes, suitable for all classes of electrical work.



PATENT BRUSH CONNECTION.

Morganite brushes are constructed in layers in such a way that the conductivity along the brush is very much higher than that of the ordinary carbon brush, thus giving a path of high conductance for current into the external circuit, while at the same time offering great resistance to currents in the short-circuited coil. The brush material is claimed to have a low friction coefficient, and to possess peculiar lubricating properties.

The Battersea brush is produced to meet the demand for high-grade ordinary carbon brushes. In both classes of brush a special method of attaching the flexible is employed, as illustrated, which ensures a positive electrical connection.

The company are also showing their patent pneumatic brush gear for turbo-generators, which was described and illustrated in our issue of March 27th last.

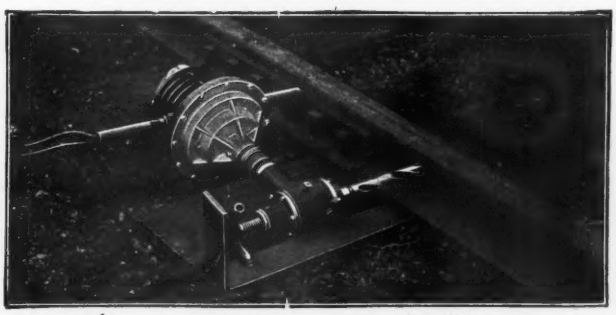
ELECTRIC GRINDING MACHINE.

The Consolidated Pneumatic Tool Co. (225).

The exhibit of this company comprises a number of portable electrically driven tools suitable for drilling, reaming, tapping, tube expanding, grinding and similar operations.

The drilling machines include small breast drills capable of drilling holes $\frac{3}{8}$ in. diameter in steel, large machines capable of drilling $2\frac{1}{2}$ in. to 3 in. in steel, and a number of intermediate sizes, which practically cover the entire range of tools required by engineers and shipbuilders for the work they generally have to do.

The outstanding feature of these machines is strong mechanical design, the lack of which has been a source of trouble in the past with portable tools. It is claimed, with, as our readers know, considerable justice, that electric tools give all the advantages of pneumatic tools, so far as economy of labour is concerned, with the additional advantage that considerable economy in power is possible. It has been found by several investigators that the distribution of power by compressed air for portable tools involves from four to five times as much power at the air compressor as is required with electric tools to do the same amount of work.



ELECTRIC RAIL DRILL.

Improvements in design which the Consolidated Pneumatic Tool Co. have introduced, have reduced the maintenance charges of electric tools to a figure quite comparable with that of pneumatic tools.

We learn that one of the leading shipbuilding firms in the country uses no fewer than 30 of the Consolidated Pneumatic Tool Co.'s machines, and their use is rapidly extending. One of our figures shows one of the company's machines adapted for drilling on a tramway track, while the other shows a grinding machine, which is now largely used by engineers for fettling castings and other work that was formerly done by pneumatic power.

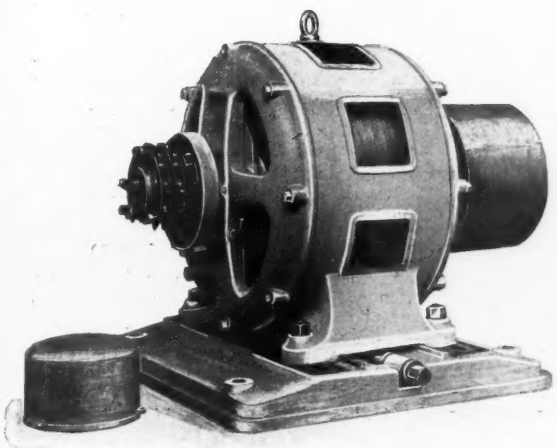
The company also show magnetic drill posts, which, of course, can be fixed to any iron or steel surface by merely turning a switch, and in this respect save the cost of bolting the pillar to the work.

The Lancashire Dynamo and Motor Co., Ltd. (47).

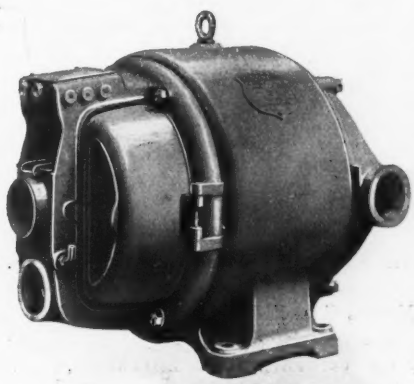
A very comprehensive display of the smaller machines built by this company is on view. That lack of experience in this particular work cannot be alleged against the firm, may be gathered from the fact that upwards of 12,000 machines have been constructed by them during the past seven years, the sizes ranging up to 1,500 H.P.

Among the machines to which we may draw attention is a 4-B.H.P. totally enclosed pipe-ventilated variable speed motor shown herewith. This machine is fitted with inter-poles, and will develop its full load output at any speed between 370 and 1,120 B.P.M., sparkless commutation being assured. A Bray, Markham and Reiss starting panel is used with this motor. The "pipe" ventilation is embodied in the end covers, and is advised for hot and dusty situations. Machines of the inter-pole type have been constructed for 1,000 KW. and upwards.

One of our figures shows a standard totally enclosed backgeared 18-B.H.P. D.C. motor for a 400-volt circuit, and another, a standard protected type wound-rotor induction motor. A similar machine to the latter, but of the short-circuited rotor type, for a 400-volt 50-period three-phase circuit, is shown fitted with helical backgear having a 7·4 to 1 ratio. A special feature of these induction motors is that copper disks with radial arms are connected to the rotor rods, with a view to giving a large cooling surface and providing a fan action.



Protected Wound-Rotor Induction Motor.



Enclosed Pipe-Ventilated Motor.

Lancashire Dynamo and Motor Co.'s Motors.

Another feature is the method of attaching the core plates to the spider, to ensure the tightness of the core.

A fly-wheel equalising set (Kelsall and Warburton patents), which is shown on this stand, is specially interesting at the present time; its function is well known to the majority of those interested in power applications.

A motor-driven winch, and a Sirocco fan similarly operated, are among the more familiar types of electrically-driven plant. Various other standard machines are shown on this stand and on those of a dozen or so other exhibitors who are running machinery in various parts of the hall.

British Westinghouse Electric and Mfg. Co., Ltd. (79, 101).

As was only to be expected, Trafford Park is well represented at the Exhibition, by the Westinghouse Co. no less than others of that ilk.

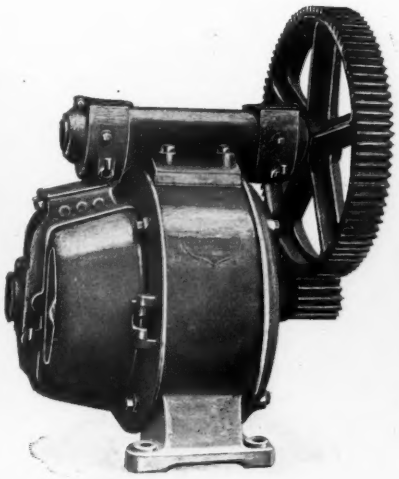
The company's stand is replete with a variety of switchgear for many purposes, also motors, arc lamps, instruments, &c.; and certain of its larger plant—a 700-KW. 6-phase 50-period rotary converter, giving pressures of 400-425 volts for lighting and 500-525 volts for traction, together with three 250-KW. 3-phase 5,500/400-volt transformers—can be seen in the Exhibition sub-station.

The switchgear, which will be fully dealt with in a later issue, is particularly interesting, being suitable for the varied industrial requirements of Manchester and the surrounding areas. Among the more prominent examples may be noted an ironclad 100-amp. unit-type panel, containing ammeter, switch-box, fuse-box, motor starter, &c., suitable for a 25-H.P. 200-volt motor; an inverted-type switch pillar for colliery and shipyard work; examples of flame-proof switchgear for motor control in fiery mines, and totally enclosed oil-switches, with detachable oil-tank, for pressures up to 3,300 volts.

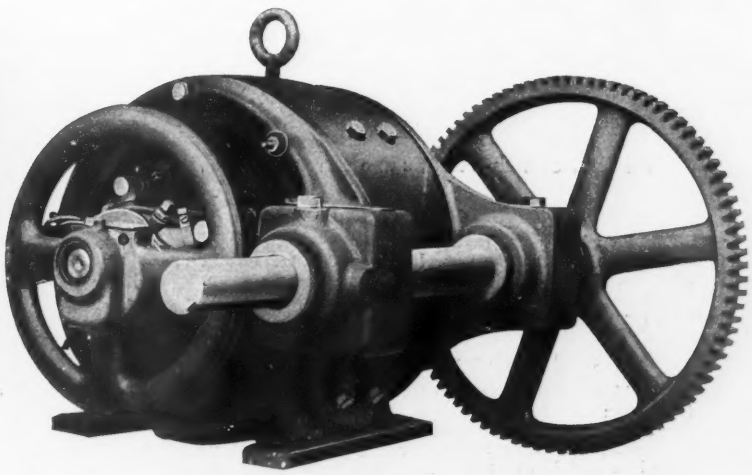
A number of controllers are on view; those for crane work are adapted for operating two or more motions with the one handle, and the star-delta controllers for squirrel-cage motors are oil-immersed, totally enclosed, and fool-proof. Among the miscellaneous plant may be mentioned the unit-type resistances, which are specially designed for easy dismantling, and are suitable for power, telegraph and telephone work; lightning arresters; brake solenoids; and an automatic transformer cut-out, arranged to cut out a large transformer on light load and connect up a small one, or *vice versa*. Several examples of the Type G motor are shown in operation. The feature of this type is the efficient air circulation which is ensured by a fan fitted on the shaft, also its protection against dripping water, &c.

One of these motors is arranged to pump water on to itself from a height of 2 ft.; another is totally enclosed, but provided with air-pipe connections; and a further example is provided with double-gauze protection to meet the requirements of the fire office rules (see next page).

A sewing machine and a magnetic separator, both motor-driven, effectively illustrate the possibilities of the very small motor.



L.D. and M. Co.'s Enclosed Back-geared Motor.



British Westinghouse Back-geared Motor.

The company have a fine display of fittings—a branch of their business which is not so well known as it ought to be—and will shortly have a 150-H.P. gas engine on view. To these and other matters we shall refer in a later issue.

BRITISH WESTINGHOUSE ENCLOSED TYPE MOTOR (see p. 597).

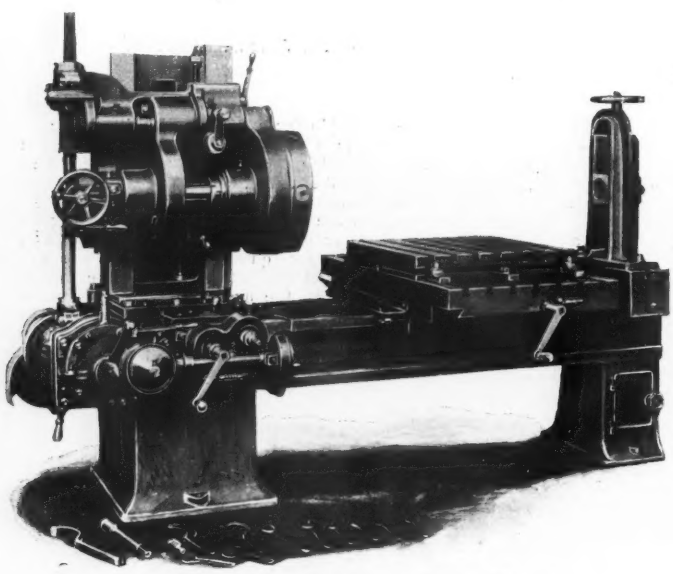
Messrs. Geo. Richards & Co., Ltd. (52).

This firm are well known for the excellence of the machine tools which they turn out from the Broadheath Works, and naturally their exhibit includes some leading examples of their work. Attention may be drawn, in the first place, to a 3-ft. boring and turning mill shown in the adjoining figure, which is motor-driven. This class of machine has proved a great favourite in recent years, superseding for many purposes the ordinary face-plate lathe. Work can be more easily set on the horizontal table, as the necessity for balancing irregular castings, &c., as on a face plate, does not exist.

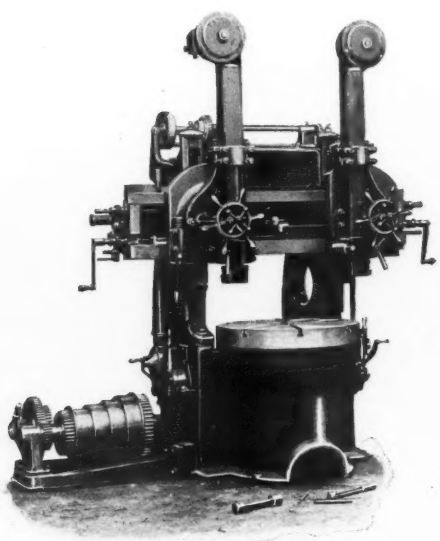
The firm build a complete range of these mills up to 16 ft. diameter capacity; they are provided with twelve rates of feed, are rigid in design, and built to guaranteed limits of error.

The patent universal facing and boring machine shown above is also on view, and is motor driven. This is designed for facing and edging the flanges of pipes, cylinders, &c., up to 22 in. diameter. The spindle is arranged for 24 speeds, ranging from 2 to 68 R.P.M., and the tables give 34 in. longitudinal and 36 in. cross travels. The machine is powerfully geared with full and intermediate back-gear trains, and is capable of taking the heaviest cuts required in facing work.

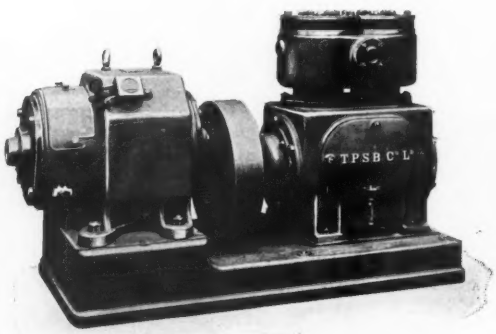
Messrs. Richards are also showing examples of Tilghman's motor-driven air compressors; one of our views, it will be noted, shows a geared drive, but both the examples on view are direct driven through a flexible coupling. The sub-bases are also dispensed with on the stand, as not being required when a flexible coupling is employed. These air compressors are by Tilghman's Patent Sand-Blast Co., Ltd.; one is approximately a 10-H.P. and the other a 30-H.P. machine.



RICHARDS UNIVERSAL FACING AND BORING MACHINE.



RICHARDS BORING AND TURNING MILL.



TILGHMAN GEARED MOTOR-DRIVEN COMPRESSOR.

A novelty in the shape of a "Blizzard" fan, a motor-driven bell, and a Midget three-phase motor busily engaged in operating a rotary liquid-sealed pump and suitable for tar, ink, hot soap, &c., are also attractive features of the stand.

The Crypto Electrical Co. (302).

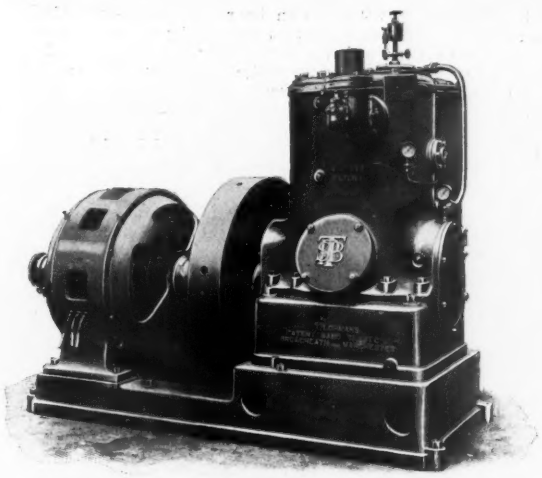
The Crypto Co. are showing a complete line of alternating-current motors, from ½ H.P. to 16 H.P., of the short-circuited squirrel cage rotor and slip-ring types; also a line of direct-current motors, from ⅛ H.P. upwards. A speciality of the company is alternating to direct-current transformers; the smallest machine shown, having an output of 100 watts, is of the combined type. The motor and the dynamo are both fitted in the same frame, but although mechanically they are practically one, electrically they are quite separate, and thus regulation of the output on the direct-current side can be obtained without any alteration of the primary side, which, of course, is a great advantage over the double-wound continuous rotary converter, in which it is impossible to obtain any regulation by means of a shunt resistance. One of the machines is transforming the 400-volt three-phase to direct current and lighting the Osram lamps which illuminate the stand. A number of direct-current rotary converters, particularly suitable for charging accumulators efficiently from high-voltage mains, can also be seen on the stand.

It will be remembered that the company originally devoted themselves to the manufacture of very small motors, but they have gradually dropped what may be classed as "toy" machines, and designed a line of machines in sizes from ¼ to 20 H.P., which in mechanical construction and electrical efficiency will compare favourably with large machines.

Messrs. Marples, Leach & Co., Ltd. (104, 105).

The company have numerous motors, ranging in size from 45 H.P. downwards, on view, in addition to a variety of switchgear, lighting and telephone material.

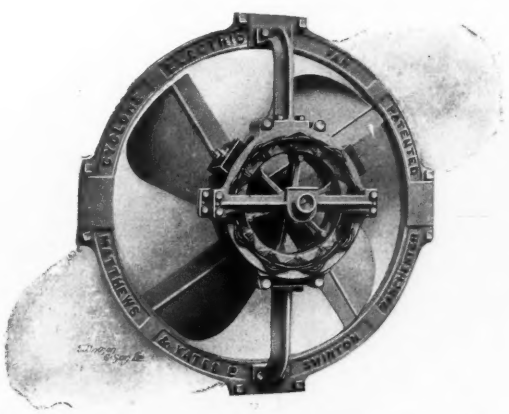
The bearings for these motors are a special feature, being fitted with a hard-rolled brass liner, which is shaped on a mandril and finished an exact fit for the shaft. The motors are of both direct and alternating-current types, the latter including the "Adnil" single-phase self-starting type.



Tilghman Direct-Coupled Motor-Driven Compressor (G. Richards & Co.).

Messrs. Matthews & Yates, Ltd. (109).

This well-known Swinton firm are showing a number of their "Cyclone" specialities, including propeller fans, blowers, separators, &c.



Cyclone Air-Propeller, with Alternating-Current Motor.

Both direct and alternating-current motor-driven propeller fans are shown in operation. These fans are standardised from 12 in. to 72 in. diameter, with direct-current motors of both the protected and totally enclosed types, also for alternating-current drives in sizes from 12 in. to 48 in. diameter, and in this case the motors can be supplied for any frequency or circuit. A quite new fan—a 42-in. Protected type Cyclone electric fan—is shown for the first time.

The motors are jigged throughout, and all parts are interchangeable. For horizontal air discharges the firm use oil ring lubrication, but with vertical and angular discharges, ball bearings and solid oil lubrication are employed.

In cases where a single-phase motor-drive is required the motors are provided with an auxiliary starting winding and a special switch, which facilitates starting up against load.

Special attention is directed to the open-blade construction, which obviously does not obstruct natural ventilation.

A number of the firm's standard electrically-driven blowers are on view, these being built for any requirement with interchangeable parts.

An interesting feature of this stand, which will appeal to visitors, is a small refuse collecting plant, which is to be shown at work collecting wood chips and shavings and conveying them through trunking.

A small steel-plate fan exhauster, motor-driven, sucks the shavings through a galvanised steel pipe, discharging them into a Cyclone separator. This latter device consists of an inverted conical trunk, into which the air and refuse enter tangentially at the top, the refuse whirling round the sides and falling to a small outlet at the bottom, while the air discharges through a short funnel of large area in the top.

This apparatus demonstrates the principle on which a number of refuse collecting plants have been installed by the firm.

These plants have been applied for collecting dust and refuse in textile, paper, woodworking and colliery installations, and in some cases the firm's cyclone humidifier has been supplied in connection with them.

A further model illustrates the application of the firm's induced draught fans for boiler plants.

The Power Plant Co., Ltd. (78).

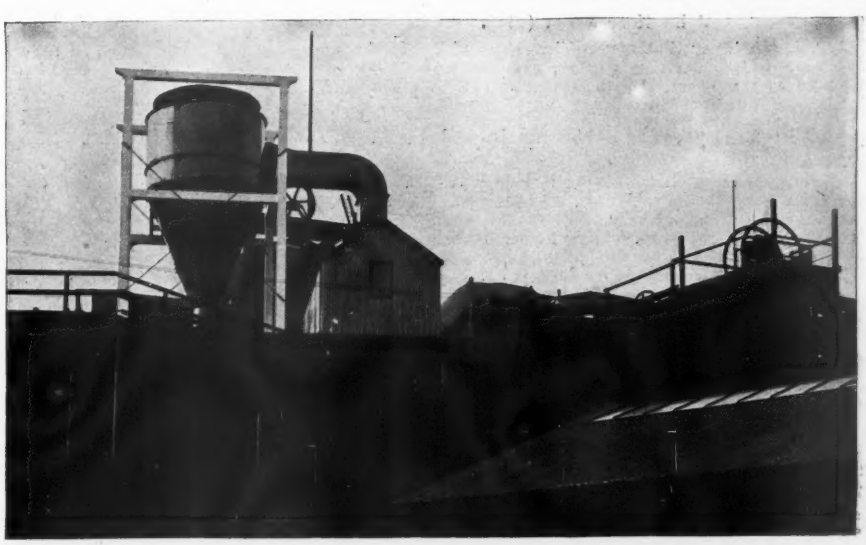
Those interested in gears should not fail to inspect this company's exhibit; the firm are sole makers in this country of machine-cut double-helical gear wheels with staggered teeth, under Wust's patent.

The unbeliever—whose opinions are frequently based on primitive gear constructions—cannot do better than investigate a 10 to 1 reduction, which the makers state will, if enclosed in an oil bath, transmit 20 h.p. with an efficiency of 94 per cent.

A L. D. & M. Co.'s motor with an 860/73 r.p.m. reduction gear; a 15-h.p. endless rope haulage, with Siemens three-phase motor and 43½:1 reduction gear; and a Westinghouse motor with miniature gear for sign work, are typical of the company's gear applications.

Double-helical gears up to 14 ft. dia., and 30-in. face, for transmitting 4,500 h.p. at 30 r.p.m. are within the scope of the company's operations.

Standard Cyclone Electrically-Driven Blower.

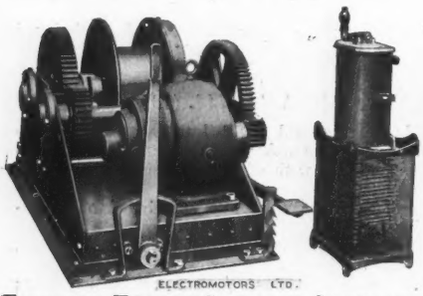


Cyclone Separator Plant, Installed at a Colliery by Messrs. Matthews & Yates.

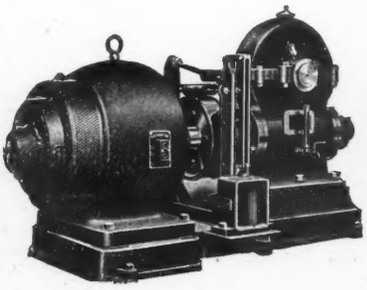
Electromotors, Ltd. (161, 133).

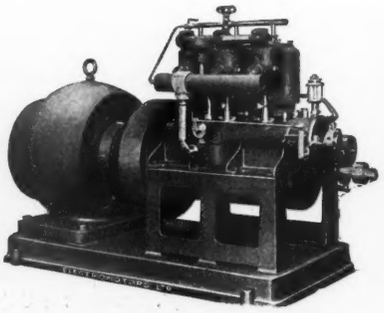
While the name of this firm largely indicates the nature of its exhibits, the average visitor will find not only motors on view, but an object lesson in how to use them. This stand occupies one of the most commanding positions and makes a really fine show. It illustrates to a nicety the application of the motor for electrical driving. A special automatic switchboard is arranged so as to operate automatically throughout the day some 20 motors and motor combinations in pairs. One pair of motors start up, run for 30 seconds, stop, and another pair start up. Simultaneously illuminated signs bearing a description of the running pair light up and go out, drawing additional attraction to the running machines, and making a very attractive display. A fine and well-finished "Luxol" sign, bearing the name "Electromotors" in large letters, faces both ways. Among the outstanding examples may be mentioned two quick-traverse winding frames for winding cotton or other yarns, each working under normal conditions and operated by an electric motor; a 5-cwt. friction hoist, designed to work at 100 ft. per minute, and driven through a combined spur and friction gear by a compound-wound motor; a main drum haulage gear, capable of hauling at 4 miles an hour, and direct-coupled to a 5-H.P. motor. This equipment is worked by a reversing drum controller, with jaw-clutch for disengaging the drum, and has a powerful foot-brake. Other items are a one-ton electric pulley block of neat design, suitable for either hand or motor travelling gear, for use on runways, &c.; electrically-driven centrifugal and ram pumps, propeller fans, drills, grinders, &c.

A feature of the stand which will not be lost sight of is the display of geared motors, the standard lift-gear combination for goods or service lifts being prominent.



ELECTRICAL HAULAGE GEAR WITH CONTROLLER.


STANDARD LIFT GEAR. ELECTROMOTORS, LTD.


PETROL-ELECTRIC GENERATING SET.

A motor-driven revolving show stand which can be turned back as the visitors require, contains a number of interesting photographs.

For private house lighting and similar work, small petrol and steam-driven generators are shown; these sets are standardised from 1 to 30 KW.

The above exhibits, of course, include the firm's standard machines, which, in one way or another, are represented in all sizes from ¼ H.P. to 30 H.P.

MISCELLANEOUS NOTICES.

Mitcham Fan Co., Ltd. (124).

The company's electric fans, which are on view, are constructed under the patents of Mr. Howard Lacey, and embody a special magnet winding of three different sizes of wire, which together with the armature leads, are mechanically grouped, by means of a control switch, in such a way as to give three or more fan speeds. No external resistance is required, commutation troubles are avoided, and considerable economy in running and up-keep results.

A 24-in. air propeller of this type gave the following results: at 900 R.P.M., 275 watts, 6,000 cb. ft. air discharge; 700 R.P.M., 200 watts, 4,700 cb. ft. air discharge; and at 500 R.P.M., 175 watts, 3,500 cb. ft. air discharge.

John Kerr & Co. (211).

The "Empire" and "Underwriters'" fire extinguishers for the protection of factories, motor garages, and public buildings, are exhibited at this stand. Up to the end of 1907 over 300,000 of these appliances had been sold.

Calmon Asbestos and Rubber Works, Ltd. (182).

This company is showing a variety of specimens of articles of which it makes a speciality. These include Para tape, insulating tape, cable tape, asbestos cable yarn, asbestos slate, a switchboard mounted on enamelled asbestos slate, asbestos slate fillets, moulded pieces for controllers, spark extinguishers, rubber matting and rubber shoes so desirable for electricians, ebonite and rubber insulating tubing. The check fire doors for power stations, &c., of the Check Fire Door Co., of Kilburn, are also displayed on this company's stand.

Drake & Gorham, Ltd. (127, 164).

In addition to the installation and fittings, &c., supplied by this firm for the lighting of the Model House, already referred to in the ELECTRICAL REVIEW, they have an exhibit at which they display their Jandus regenerative flame arc lamps (70 hours' life with one pair of carbons). Their switchgear (manufactured at their works at Felix Street, Westminster Bridge Road), of which fully illustrated particulars were given in the ELECTRICAL REVIEW about a year ago, is also in evidence. Motors and pumps, metallic-filament lamps and various fittings suitable for them, and magnetic clutches and other specialities for which the company is pretty well known, are also present.

National Telephone Co., Ltd. (65).

This exhibit includes a private branch Exchange, providing telephone service to the principal exhibitors, and call offices adjoining the main entrance, for the use of visitors. It represents a standard private branch Exchange as supplied for large offices, warehouses, works, &c., enabling both inward and outward calls to be handled more directly and more expeditiously than by any arrangement of direct lines not worked by a switchboard on the subscribers' premises, and with the additional advantage that the caller can be directly connected with the person with whom he wishes to speak in either his own office or department. The switchboard installed is of the standard common-battery type, equipped for two operators' positions, 100 extension lines, and 40 junctions to the main Exchange. There are 15 connecting cord circuits per position, each provided with two supervisory signals. The extension lines call automatically on magnetic visual signals at the switchboard, when a telephone is removed from its rest, and the junction circuits are so arranged that they may be worked either for incoming or outgoing calls.

The current required for speaking and signalling purposes is supplied by a battery of 11 accumulators, charged over special power leads from the main Exchange.

A standard pattern test board, fitted with lightning arresters and heat coils, is installed for the convenience of testing the subscribers' lines, and for the purpose of protecting the equipment from lightning and stray high-voltage currents.

Alexander Kenyon & Co. (267).

This firm exhibits a representative collection of its engineers' stores, tools, and engine-room and electric light station accessories and sundries—including oil economisers, rubber goods, engine packing, &c.

Harper Electric Piano Co., Ltd. (163).

This exhibit hardly calls for notice, but it consists almost solely of the Harper pianos, which are electrically "worked" and electrically lighted.

Pearson & Co. (258).

Messrs. Pearson & Co., electrical contractors, of Manchester, are at present carrying out a large number of house-lighting contracts in the Manchester area. Their exhibits include the Watkin switch, for which we learn the Japanese Government has placed a large order. A small electric sign, suitable to fix on office doors, &c., indicating whether the occupant is engaged or at liberty, is also shown. Messrs. Pearson & Co. have on their stand the "Archer" electric cooking range, with which they will entertain the visitor with demonstrations.

Waltham Arc Lamp Co.

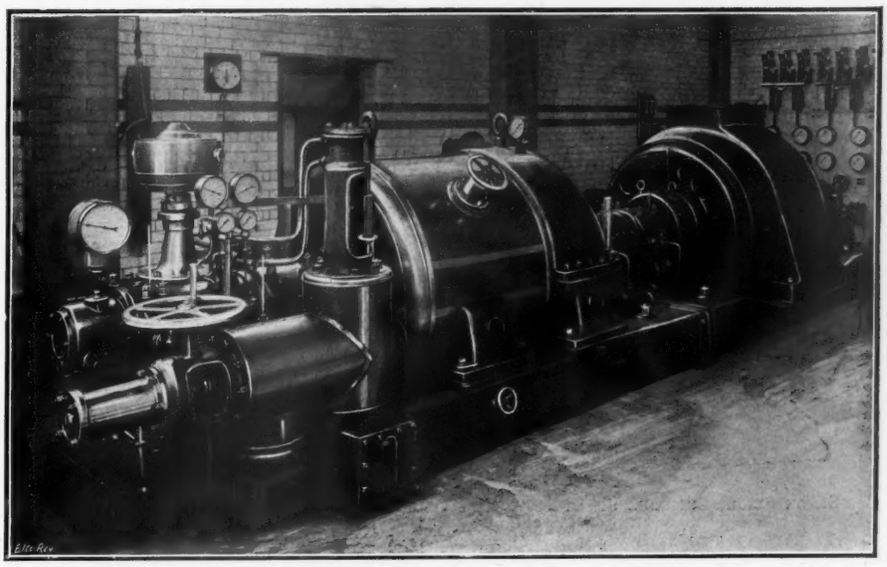
This company is exhibiting its patent arc lamps, including a new enclosed flame lamp, which burns from 20 to 40 hours at each renewal with one carbon, and the power consumption of which is 400 watts. The company is also showing an enclosed lamp which is made in two capacities, namely, Standard type, 500 watts, and economical type, 350 watts, its special features including the elimination of the dash-pot on alternating-current circuits, and a simplified and improved method of removing and fixing the globe before and after trimming. From 40 to 60 burning hours, according to circuit, are claimed for this lamp.

POWER PLANT EXHIBITS.

[In this Section we give particulars of some of the leading examples of Steam and Electric Generating and other Power Plant and Apparatus now on view at Manchester. Other Exhibits in this class will be included in a later Supplement before the close of the Exhibition.]

Messrs. John Musgrave & Sons, Ltd. (53).

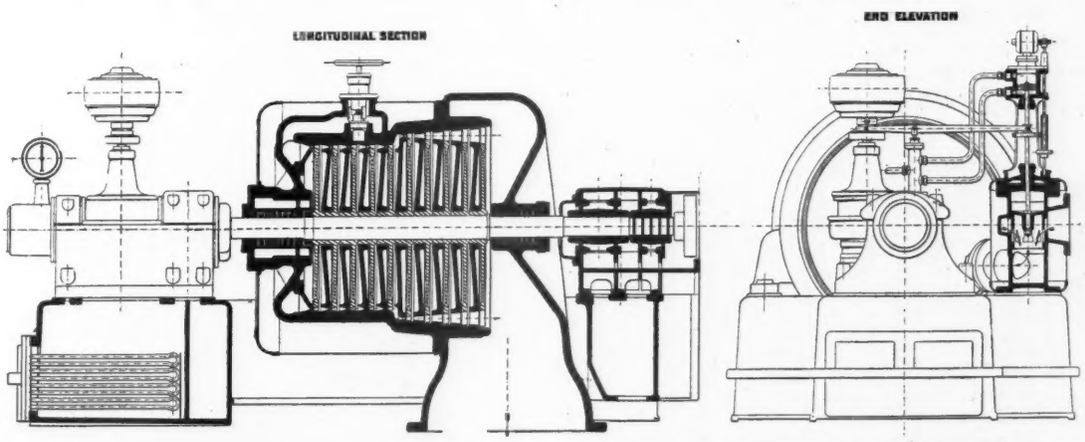
One of the finest engineering exhibits, and one which will undoubtedly command a good deal of attention, is shown by this firm, whose engines are familiar among power station engineers. Messrs. Musgrave are showing, first and foremost, a 600-kw. Zoelly steam turbine directly coupled to a Siemens 500-volt, 50-period three-phase generator, together with direct-coupled exciter. The adjoining figure shows the set exactly as it is to be seen at the Exhibition. The turbine has the top half of the casing removed and replaced with glass, &c., so that the whole of the interior is visible. It is driven by an electric motor for the purpose of showing how perfectly balanced it is, and also to show the operation of the governor, oil circulation, &c. This turbine has been manufactured by Messrs. Musgrave to the order of Messrs. Siemens Bros. Dynamo Works, Ltd., for the Falcon Mill Co., Ltd., of Bolton, and is one of two being supplied for driving a spinning mill for superfine yarns, of 100,000 spindles. The duplicate of the machine on exhibition is at present at work on site driving the mill. Each turbine is to have a normal output of 400 kw., but each is capable of giving an output of 800 kw. for 10 hours continuously, and so can drive the whole mill in the event of an accident happening to the other set. These two turbines—the one at the Exhibition and the one working at the Falcon Mill—are the first two "Zoelly" turbines which have been entirely manufactured in England, having been built complete in every part at Messrs. Musgrave's works at Bolton.

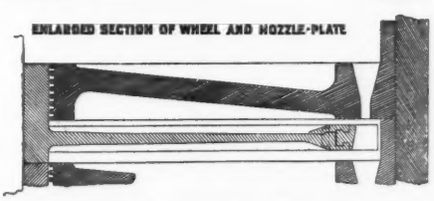


Musgrave 600-kw. Zoelly Turbine and Siemens Generator.

Messrs. Musgrave & Sons are also showing a superheater attached in position to a dummy boiler end, so as to show the arrangement and setting required for it when used in the down-take of a Lancashire boiler.

Messrs. Musgrave have just booked a substantial contract for the Bury Corporation for their Zoelly turbine sets, the work being given to them because of their ability to give quick delivery, the plant being urgently required. We believe that this contract was booked during the preparation of the exhibit in the Hall. It is for two 2,000-kw. sets complete with condensing plant, &c.





Sectional Elevations of Zoelly Turbine, and Detail Section of Wheel.

There is also on exhibition at this stand an electrically-driven barring gear, which has been manufactured for use in conjunction with a slow-speed vertical cross-compound engine of 4,000 I.H.P. maximum output, made for the City of London Electric Lighting Co., Ltd., at their Bankside station. This will make the sixth engine of this size and type manufactured by Messrs. Musgrave and Sons for the Bankside works.

It will interest our readers, particularly those who have to do with matters relating to power station equipments, to know that the firm has just issued an excellently got-up catalogue in which a well illustrated description of the Zoelly steam turbine and its various parts is given, with points concerning its advantages, also a table of dimensions, weights and guaranteed full-load steam consumptions. Exhaust steam turbines and mixed pressure turbines are also described, and a number of pages of useful tabulated data relating to the properties of saturated steam at pressures from 1 to 300 lb., thermal properties of metals, specific gravity and weights of metals, British standard table of conductors, legal standard wire gauge, fuse tables, weights and measures and conversion tables. A large folded-in sheet gives an entropy table for steam.

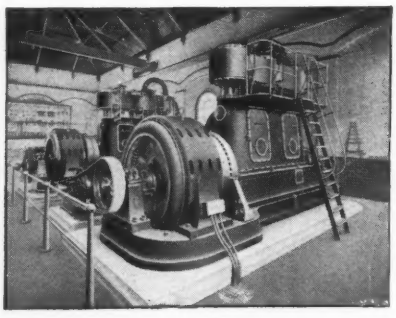
Messrs. W. Sisson & Co., Ltd. (266).

Five engines are shown on Messrs. Sisson's stand, all of the vertical high-speed double-acting enclosed type with automatic lubrication; these range from a single-cylinder engine of 7 B.H.P., running at 800 R.P.M., to a 70-B.H.P. two-crank compound engine running at 600 R.P.M. An intermediate size—21 B.H.P., single-cylinder—is shown in the accompanying illustration. The general features of the Sisson engine are well-known to our readers; the partially superposed high-pressure cylinder in the compound pattern in particular is a distinguishing characteristic, and the convenience of access to the working parts is noteworthy. The speed is controlled by Sisson's patent automatic expansion shaft governor, which regulates the momentary variation to within 5 per cent. in the larger sizes, and the permanent rise to 2½ per cent., from full to no load; this valve gear provides for throttling at low loads, and thus combines the economical advantages of both throttling and variable cut-off. The speed can be adjusted while the engine is running. Very high steam economy is claimed for the Sisson engine on varying loads, as well as small oil consumption. It should be mentioned that the firm make engines up to 1,800 B.H.P.

SISSON SINGLE-CYLINDER STEAM ENGINE DRIVING DYNAMO.

Messrs. Howden & Co., Ltd. (69).

The two vertical engines exhibited by Messrs. Howden are of their double-acting high-speed type. The smaller engine is of the two-crank compound type, having two cylinders side by side, with piston valve between. The output is about 60 B.H.P. with steam at 120 to 160 lb. pressure, condensing or non-condensing, at a speed of 600 to 650 R.P.M. The larger engine, which is illustrated herewith, is triple-expansion, of similar design, with a piston valve to each cylinder, and is capable of developing about 250 B.H.P. at 450 R.P.M.



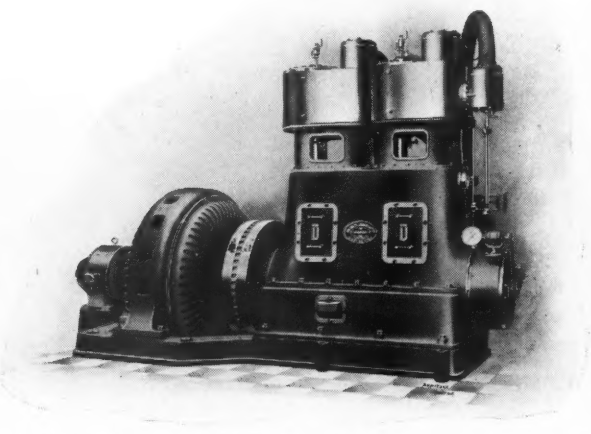
HOWDEN 600-KW. ZOELLY TURBINE.

These engines have been specially designed to deal with heavy fluctuating loads, and are provided with forced lubrication to all working parts. The materials used are of the very highest quality of their respective kinds, no cast-iron being used in any of the working parts of the engine taking direct stress, and all the working parts are enclosed. The Howden engine is made in standard sizes from 5 B.H.P. to 2,500 B.H.P., both compound and triple-expansion types, and has been very largely adopted for power and lighting, some 50,000 H.P. being at work.

Besides the foregoing engines, Messrs. Howden & Co. exhibit a turbine rotor, part of a 600-KW. Howden-Zoelly impulse type turbine, which we illustrate; this is of similar construction to one of 6,000 KW. which they have in hand for the Corporation of Manchester. In their latest type Messrs. Howden have made some important modifications in the mechanical construction, which they consider will be of great advantage to the user. They have supplied or on order one 6,000-KW. set, six turbines of 1,000 KW., and several of smaller sizes.

Messrs. Browett, Lindley & Co., Ltd. (21a & 47a).

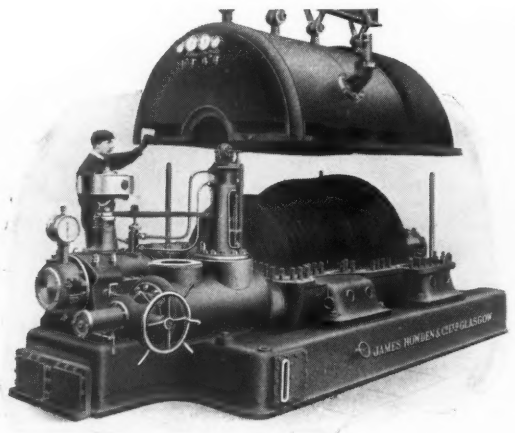
The engine exhibited by this firm is one of their well-known standard two-crank compound double-acting engines, with piston valves to all cylinders, and forced lubrication. The governor is of the crankshaft centrifugal type, acting directly on the throttle valve. The engine is coupled directly to a standard generator of the Lancashire Dynamo and Motor Co.'s make, and is capable of developing an output of 225 KW., either condensing or non-condensing, at 375 R.P.M., with a steam pressure of 120 to 140 lb. per sq. in. Similar engines are made from 20 to 500 KW., and triple-expansion and three-crank compound engines from 150 to 1,500 KW. The one exhibited is illustrated herewith.



BROWETT, LINDLEY COMPOUND ENGINE AND LANCASHIRE DYNAMO.

Messrs. Babcock & Wilcox, Ltd. (230).

Messrs. Babcock & Wilcox exhibit a model boiler fitted with steam superheater and mechanical stoker, a model water-softening plant on the Lassen & Hjort system, which they handle under licence, and a collection of steam piping, &c. To describe the Babcock boiler and superheater to our readers would be a superfluous proceeding, as they are already familiar with it. The special feature of the water-softener is its simplicity; the apparatus is automatic, the supply of water being regulated by a float valve, and that of the chemicals by a patent automatic measuring device. The apparatus is very compact, and requires little attention. Special plant has been put down for dealing with pipe-work at Renfrew; up to 10 in. diameter the pipes are of weldless mild steel, above that size of lap-welded steel, and the flanges are of wrought mild steel pressed out of the solid.



HOWDEN TRIPLE-EXPANSION VERTICAL ENGINE AND GENERATOR.

Messrs. Mirrlees, Bickerton & Day, Ltd. (244a).

This exhibit consists of a three-cylinder vertical Diesel oil engine of 150 B.H.P., directly coupled to a dynamo made by the Lancashire Dynamo and Motor Co., which generates at 230 volts. Switchgear and resistance is provided on the stand, to enable the engine to be run up to full power, and to demonstrate the governing qualities of the engine and its running under various loads. The engine will also be run on various classes of oil, so that the demonstration should be of special interest.

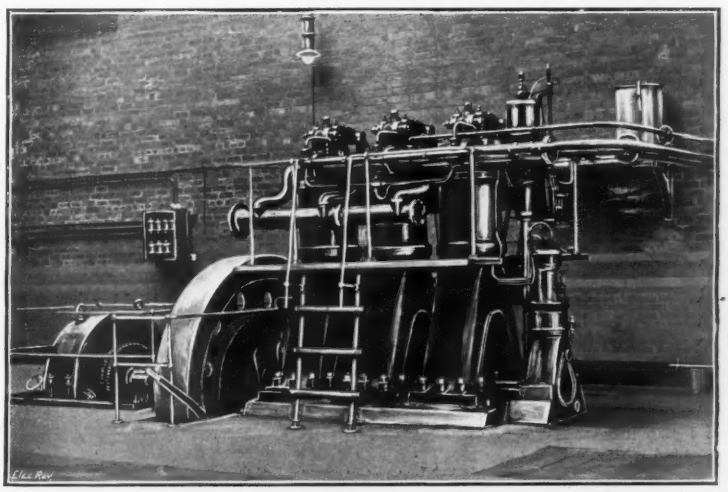
The main features of the Diesel oil engine are known to our readers. Its extreme fuel economy over wide ranges of load is undeniable; at full load the consumption of fuel oil is guaranteed not to exceed 0·5 lb. per B.H.P.-hour, and at half load not to exceed 0·6 lb. per B.H.P.-hour. This means that, with oil at 65s. per ton, the cost of fuel per KW.-hour is 0·26 of a penny at full load, and at half load 0·31 of a penny. Its adaptability to the use of all kinds of cheap residual and crude oils with safety and economy, without any adjustment whatever being required, is an important advantage; in fact, the engine will use any mineral fuel oil which is free from tar and other deleterious matter, and which is not too thick to flow readily through the pipes.

Its governing qualities are excellent; and as the engine is started with compressed air, it can be run up and put on load in 50 to 60 seconds—a great advantage in electric power stations.

Accessibility of parts is one of the leading features of its design; any valve on the engine can be changed and the engine started again in 10 to 15 minutes. Moreover, as the oil used is ignited by the heat produced by the compression of the air, no troublesome igniting device, carburettor or vaporiser is required.

The makers are at present manufacturing engines in sizes from 35 B.H.P. to 200 B.H.P., at speeds varying from 200 to 400 revs.; they also have in hand an engine which will be capable of developing continuously 600 B.H.P. at 200 R.P.M., and have supplied to the Admiralty a large number of high-speed engines running at 400 revs. for use in the British Navy, for ship-lighting and power purposes. Since the first of these engines was fitted in H.M.S. *Dreadnought*, they have supplied engines of similar type for every subsequent battleship and large cruiser.

Messrs. Mirrlees, Bickerton & Day have recently built and equipped entirely new works, which are specially designed for the rapid and accurate production of "Mirrlees-Diesel" engines. The machinery is driven by electric power supplied by one of their own engines, coupled direct to a D.C. generator, an exact duplicate of the generating set being exhibited at the Electrical Exhibition, which is illustrated herewith.



Mirrlees-Diesel 150-B.H.P. Engine and Lancashire Dynamo.

Galloway Superheater, Open.

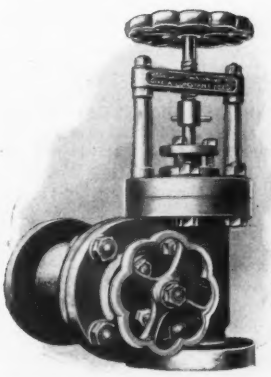
Messrs. Galloways, Ltd. (72).

This firm exhibits a patent "Galloway" flue for a 7-ft. diameter cylindrical internally fired boiler, containing 15 patent cone tubes, the distinguishing characteristic of the Galloway boiler. A front end plate, for a patent five-flued boiler with angle ring for connection to shell, and the first ring of each of the five flues, is shown with the fittings in place. This boiler has been specially designed in order to utilise the waste gases from coke ovens. Two patent wrought steel steam superheaters are also exhibited, each containing 29 tubes, one with cover bolted on complete, and the other with cover loose. The special feature of this superheater is that it is built entirely of Siemens-Martin mild steel, and is quite as strong as any portion of a steam boiler. It is illustrated in the accompanying figure. This superheater is inserted in the downtake at the back end of Lancashire boilers, and is provided with a safety valve. The "Perfect" junction valves fitted with Galloways' improved arrangement for rotating the valve on its seat whilst under pressure; feed valves; gun-metal parallel-slide blow-off taps; patent high-steam and low-water safety valves; and a model of a Galloway boiler, are the other principal features of the stand.

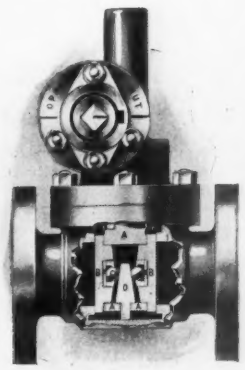
Messrs. E. Green & Son, Ltd. (111).

Messrs. Green & Son are showing a model of Green's economiser containing 72 heating tubes, fitted to a model water-tube boiler complete with feed piping, pump, valves, &c. They are also exhibiting a model of their economiser containing 96 heating tubes, fitted to the model of a Lancashire boiler. This economiser is arranged in two groups of 48 tubes each, and is fitted with all the latest improvements and facilities for easy access to any part of the apparatus. The scraper gearing of both models is actuated by small ½-H.P. motors.

Show cases of prize medals awarded to "Green's Economiser," photographs, sample tubes and castings, &c., complete the exhibit.



"Shaw" Combined Feed and Check Valve.



"Shaw" Patent Blow-off Valve.

Messrs. Joseph Shaw & Son, Ltd. (140).

Messrs. Joseph Shaw are exhibiting specimens of all the steam valves that they make. The essential principle of their parallel-slide valve is shown in the figure above, which gives a part sectional view of the "Shaw" patent blow-off valve. The valve has a straight thoroughfare of full bore, and moves easily into place. The disks B B are held in a ring A A, and are pressed tightly against the seats when closed by the wedge D and the balls C C, with bearing plates E E. A special packing ring F on the spindle forms a steam-tight joint when the valve is open. It will be seen that the disks slide smoothly past the faces of the seats

clearing away all dirt and sediment, and when closed are perfectly tight. The figure shows also the improved locking gland, which prevents the key from being removed until the valve is absolutely closed, so that the blow-off cannot be accidentally left open when the key is removed. The other figure shows the "Shaw" combined feed and check valve, in which the check valve can be examined and repaired whilst the boiler is under steam by closing the additional valve in the branch. Besides a variety of other valves, cocks, steam traps, &c., a special feature of the exhibit is the firm's "Nico" metal, which is specially suitable for use with superheated steam, and is used for valves and seats.

The Hart Accumulator Co., Ltd. (213, 190).

A complete battery of 30 "1908" lighting type 11-plate cells, complete with acid, &c., erected on two-tier wood stands, and having a capacity of 300 ampere-hours, is shown on the Hart Accumulator Co.'s stand. The capacity is 120 ampere-hours, when discharged in one hour. The cells are fitted with patent non-corrosive terminals.

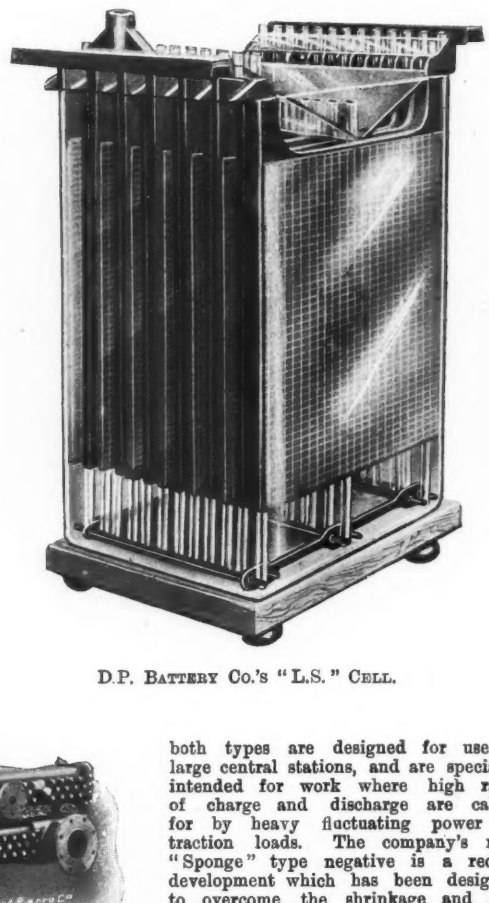
Copper rod connections are shown joined to the cells, and the company's patent sheet separators are used, which prevent internal short-circuits, and render it unnecessary for the attendant to examine the cells every week. The plates are spaced widely apart with $\frac{9}{16}$ in. diameter glass separators, and there is a clearance beneath the plates of $3\frac{1}{2}$ in., so avoiding the necessity for periodically cleaning out the cells.

These batteries can be supplied in glass boxes with capacities ranging from 120 to 960 ampere-hours; above this size, wood lead-lined boxes or lead tanks are used.

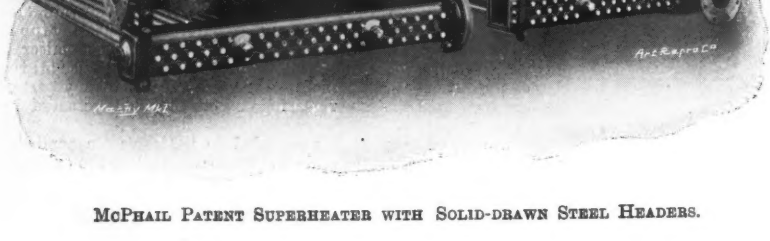
A battery of six "C L" type cells in glass boxes, complete with all accessories, and mounted on wood stands, is also shown. A clearance of 6 in. is provided beneath the plates. These cells are specially suitable for central station work, and can either be fitted with solid lead burnt connections, or non-corrosive terminals. These range up to 1,045 A.H. in glass boxes; larger sizes are mounted in lead or lead-lined boxes, up to 3,000 A.H. capacity. The foregoing, with the "C S" and "L C S" types, are suitable for power stations. Many other patterns are exhibited, including the "T" and "S" types for small installations, portable work, &c., traction cells, ignition batteries in celluloid boxes, and a variety of plates, separators, instruments and accessories.

The D.P. Battery Co., Ltd. (142).

The accompanying figure represents the D.P. Battery Company's "L.S." type in glass boxes; the "L.S.H." type of cell in wood lead-lined boxes, is also shown, both types are designed for use in large central stations, and are specially intended for work where high rates of charge and discharge are called for by heavy fluctuating power or traction loads. The company's new "Sponge" type negative is a recent development which has been designed to overcome the shrinkage and disintegration of the active material inseparable from the Faure type of plate. The active material now used is so constituted as to resemble a sponge in consistency, with a tendency to expand rather than to contract. The perforated screen which covers the face of the plate prevents the active material from falling away, and at the same time allows the electrolyte free circulation and access to it. The "D.P." positive plates are of the Planté type, and are formed by the company's own process, which produces, on the enormous superficial area obtained by the vertical ribbed formation, a tough, hard and strongly adherent skin, which is unaffected by the heaviest rates of charge or discharge. The ribbed design of the plates, with its horizontal binding ribs, results in a rigid structure which is capable of expanding in any direction without buckling, whilst admitting of the free action of the electrolyte throughout the plate, and gives ample storage capacity. Many other cells are exhibited on the "D.P." stand, designed to meet practically every demand of electrical energy, from the small ignition cell of the motor-car to central station cells of 15,000 ampere-hours capacity.



D.P. BATTERY CO.'S "L.S." CELL.

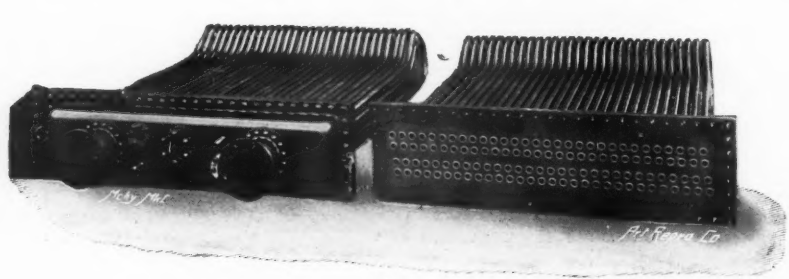


MCPHAIL PATENT SUPERHEATER WITH SOLID-DRAWN STEEL HEADERS.

Messrs. McPhail & Simpson, Ltd. (114).

The exhibit on this stand embraces a variety of items, almost all relating to superheaters. Messrs. McPhail & Simpson being pioneers in superheated-steam practice, their apparatus is well-known and needs little description.

A prominent feature of the exhibit is a complete downtake superheater, with a dished box header of Siemens-Martin steel $\frac{7}{8}$ in. thick; this is shown complete in the adjoining illustration, together with a similar one without the cover, showing the tubes expanded in the tube plate and beaded over. Another important item is a more elaborate type of superheater, in which McPhail's patent square box, solid-drawn, wrought-steel headers are employed; one of our illustrations shows two forms of this superheater, one having the inlet and outlet at the ends, and the other having them at the top, the blocks in the latter case being of weldless wrought-steel riveted on. The headers are provided with hand-holes, and a conical plug stopper with box nut is fitted opposite the end of each tube for the insertion of the expander spindle, on McPhail's patent system. Other exhibits are various parts of superheaters in course of manufacture, a high-temperature superheater, specimens of tubes which have been at work for ten years (in the first Babcock boiler ever fitted with a superheater) and similar examples, and stop valves specially constructed for superheated steam.



MCPHAIL SUPERHEATER WITH DISHED BOX HEADER.

LANCASHIRE MILLS AND ELECTRICAL DRIVING.—II.

By F. J. A. MATTHEWS.

Another installation worthy of note is that of the Kearsley Spinning Co. near Manchester. This is a new mill driven throughout electrically, the work having been carried out by the Electrical Co. A three-phase alternating-current system is adopted, the motors being all started from the power house. The current is derived from turbine-driven alternators, a feature of these machines being the water cooling system which has been adopted not only for the bearings but for the machines generally.

One of the first mills to be electrically driven throughout is that belonging to Messrs. Ashworth & Hadwen at Droylsden, near Manchester. The mill contains 88,900 spindles and 900 looms, and used to be driven by a beam engine built in 1834, the power being transmitted through upright shafts, bevel wheels, and heavy shafting. In some cases where the line shafts in different departments were not in line, diagonal shafts and bevel gears had to be resorted to. When it was decided to replace the old engine the question of electrical driving was carefully considered by the firm, with the result that Messrs. Drake and Gorham received an order for the complete electrical equipment of the mill. The power is generated on the opposite side of the yard to the old mill engine by means of a B.T.-H. alternator directly coupled to a Willans turbine, and is distributed throughout the mill by means of 24 motors aggregating over 1,000 H.P. The new drive is much simpler than that which formerly existed, the risk of breakdown is considerably reduced, the turning moment is steadier, and the driving more economical.

Much of the success which has attended the later efforts of electrical firms to induce millowners to adopt electric driving has been due to the fact that the leading firms have specialised on mill work, and can put forward plant which is eminently suitable for the purpose. In the same manner as the manufacturing firms have found that it is to their advantage to devote special attention to mill work, the engineers in charge of the public supply have also decided that it is profitable for them to cater for this class of custom, and while there is much reticence as to the actual rates charged, it is possible for a mill owner to obtain a supply either from the Corporation or the Lancashire Electric Power Co., as the case may be, which will compare favourably with the cost of running by steam, especially if the saving in interest and depreciation on the costly generating plant which is not necessary be taken into consideration.

At the present time in Bolton 220,000 spindles are electrically driven by the Corporation supply, while some 150 H.P. is supplied for the driving of auxiliary machinery in connection with cotton spinning, and judging by the number of inquiries that have been made there is every reason to anticipate that this number will be largely increased in the near future.

The Brunswick Mill, belonging to the Bannerman Mills Co., is driven electrically, the installation having been carried out by the British Thomson-Houston Co., and two floors of the Butler Street mill, belonging to the Fine Cotton Spinners' Association, have been electrically equipped by Messrs. Mather & Platt, the current in each of these cases being supplied by the Manchester Corporation, while there are over 100,000 spindles and 1,000 looms driven electrically in Lancashire by current supplied by the Lancashire Electric Power Co.

A full description of the installation of the Premier Mill, Stalybridge, appeared in the Electrical Review on August 28th. The installation was carried out by the British Westinghouse Co., and possesses some interesting features. The current, which is obtained from the Stalybridge, Hyde, Mossley and Dukinfield Joint Board's main generating station, is supplied to the mill at a pressure of 6,000 volts, and is reduced by means of three 250-KW. transformers to 400 volts, at which pressure the motors are designed to operate. With the exception of two 150-H.P. motors driving ring spinning frames, and an 80-H.P. motor driving the slubbing and roving frames, all the motors are of the squirrel-cage type; the three motors referred to are of the slip-ring induction type.

As numerous other instances could be given of mills electrically driven, it is evident that notwithstanding the fact that at one time it appeared as though little would be done in this country in connection with the electrical driving of cotton mills, the owners have now made up for the delay in making a commencement, and there is every prospect that in the future the Lancashire mills will generally be driven electrically. The bulk of the orders will continue to go in the future, as in the past, to those firms who make a speciality of mill work, and who devote the necessary attention to the peculiar requirements of the equipment of these mills.

There is not the slightest doubt that the electric drive possesses many great advantages over the mechanical drive, apart altogether from the question of whether it be more economical or not, and even regarding the question of economy, recent figures have shown that with an installation carefully planned and properly carried out, the electrical drive gives an increased efficiency over the mechanical drive.

The other advantages may be tabulated as follows:—

1. Flexibility and simplicity of the equipment.
2. The power absorbed by any machine can be readily checked.
3. The ratio of output to energy used can be easily ascertained.
4. The position of the power house is not fixed, but can be located in the most suitable situation without reference to the position of the mill.
5. Extensions can be effected without interfering in any way with the working of the mill.
6. The various departments are isolated as regards the power plant, and a stoppage in one department does not in any way affect the rest of the mill.
7. Increased production, due to a higher speed and steadier turning moment.

Considering these advantages, it is evident that by no other means can power be so easily and economically conveyed to any portion of the mill; no long lengths of shafting are kept turning round continually for any auxiliary machinery that is only occasionally used.

One of the most difficult things to discover in a mechanical drive is the power required by any individual machine. The usual method adopted is to take indicator diagrams, but this is far from satisfactory, as it is seldom that two similar readings are obtained, and in any case an allowance has to be made for friction; and if a friction diagram be first taken, it is not correct to assume that the light-load friction of the transmission system is the same as the full-load friction. Mr. Paine in a discussion on electric driving some years ago referred to a case where two spinning frames identical in all respects were found to require different amounts of power. With an electrical drive it is easy to insert a watt-hour-meter in the circuit of any machine, and the energy taken during a given period can thus be compared with the output. In the same manner, with recording apparatus on the main board the total energy absorbed in the mill may be compared with the output, and as in cotton mills the energy should bear a definite ratio to the output, it is a matter of great importance to be able readily to localise any source of loss.

It is unnecessary to refer to the ease with which extensions can be made, or to the fact that a stoppage in one department will only affect that one department. Some time ago the writer was in a textile mill in the West of England when the whole mill was shut down for ten minutes, to repair a defective bearing in a minor department, and this incident was probably the final cause of the owners deciding to adopt electric driving.

Perhaps the most important advantages are the higher speed and steadier turning moment. The high-class engines found

in the modern mill will give as steady a turning moment as can be required, and if a tachograph be fitted it will generally be found that the curve obtained is practically a straight line, but if the tachograph be fixed on to some of the shafts, a different result will be found, and there will be evidence of more or less irregular turning. The irregularity will be most marked on the shafts furthest from the source of power, and especially on those shafts driving mules and other intermittently loaded machines; with the electric drive this irregularity will disappear, and a perfectly steady drive will be obtained in all parts of the mill.

It was mentioned above that since it was desirable to start up the entire mill at one time, it was not easy for an owner to make experiments by putting down a dynamo driven off the main engine. It is possible, however, to do this, and start the electrically-driven departments at the same time as the mechanically-driven portions, if proper precautions are taken. An instance of this has recently occurred in a Lancashire mill. The mill was driven from two engines—one fully loaded, the other capable of developing 1,500 H.P., only half loaded; when extensions were made it was found better to make them at the end of the mill which was driven by the fully-loaded engine, and as the power had to be taken from the other engine it was a question of either adopting the electric drive or making very costly alterations in the shafting. The former scheme was finally adopted.

It was essential that the dynamo should be driven from the large mill engine, and also that all the mill should start up at once, and the difficulty was surmounted by using squirrel-cage motors and a separate steam-driven exciter; the alternator was first excited before the main engine was started, so that the motors came up to speed with the engine, no starting switches or auto-transformers being included in the equipment. This arrangement is quite satisfactory, and is, in fact, similar to that adopted by the Westinghouse Co. in the installation they carried out for driving the mills of Sir Titus Salt, Sons & Co., at Saltaire.

Generally it may be said that there is a decided advantage to be gained by adopting the electric drive in textile mills, but it is necessary that each mill be considered on its own merits. Some few years ago there was a discussion between the advocates of the direct drive and the advocates of the group system, and we were promised that in the near future each individual loom and each spindle would be fitted with its own motor. The direct drive does not appear to have made much headway, certainly not in Lancashire, the whole of the work so far done in the country being designed on the group system, and it is probable that future work will also be carried out on the same lines, although it is possible that in the future the motors may be directly connected to the line shafts and less attention paid to the assumed necessity of the belt or rope forming a flexible coupling between the motor and its work.

ADVICE TO EXHIBITORS.

BY AN OLD HAND.

"GLAD when it's over?" So? Strain great? Better business is greater! Never say die!

. . . . . .

You've done well so far. It only remains for you to keep it up—or do better!

. . . . . .

You've got the best stand in the show? Everybody has—in his own opinion. Quite right, too! Believe it! Keep it so all the time. Until the night of the 31st!

. . . . . .

Remember the hours! 10 a.m. to 10 p.m. Don't cover things up too early. Think what you may lose if you do! May-be more than all you gain at other times!

. . . . . .

Study your assistants. Something wrong? Don't get ratty! They tire as well as you! They've worked as well in their way as you in yours—some of them. Pull all together!

. . . . . .

"Does it pay to exhibit?" Listen! Does it pay to get known among the very people who are looking for your stuff? Answer *that!*

. . . . . .

The contractors are coming—prices are not too undercut for *that*. They've got to come, and they know it. Be ready!

. . . . . .

Lock out for the borough electrical engineers! And their Committees! Did you hear about that big contract booked in the Hall last week? Before the Exhibition was opened, too!

. . . . . .

Don't think any day unimportant! Every day is convenient for somebody!

. . . . . .

On Saturday the public in their thousands. Another day you may get "One Millowner." Who hasn't converted. Whose mills are idle. Now's his time. And yours too. "Remember Lot's wife!"

. . . . . .

If you *must* thump with that hammer, remember that pianos sometimes annoy next-door neighbours!

. . . . . .

Let it beat well in time with the Coldstream Guards—if it *must* go while the band plays.

. . . . . .

We heard things about that hammer last Saturday—after it stopped! We *tried* to hear them on the next stand while it was going!

. . . . . .

If you must make a noise in the world do it quietly, or in print!

. . . . . .

It's a Motor Show. Keep your motors at work, for in the words of the comic song, "It's Motor Here, Motor There, Motor all over the Shop."

. . . . . .

Steady with your Matches. There is timber about and other stuff to burn, including one or two electrical papers! Wouldn't boom electricity to have a Fire at Rusholme! Would it?

The Electrical Industry is not dead. It only slept! And while it slept it dreamed! Nightmare? Had been feeding on—what?

. . . . . .

"Go to the ant, thou sluggard!"

. . . . . .

Sweet are the uses of advertisement. Competition is good—in reason. Before you were born—and still here! The ELECTRICAL REVIEW for ever!

. . . . . .

To the man at the wheel! Stand attendants attention! Be on the alert. Be obliging. Your employer's business is your business! His success is yours—if you make it!

. . . . . .

You can help the electrical industry if you will. It'll be bigger before it's less. Going to stay in it all your life? Then boom it for all you are worth. Your booming is worth something—a great deal in fact. It'll do you good— and the trade too!

. . . . . .

Buckle up your belt now, make things hum! You'll have to let it out six holes later on.

. . . . . .

"They also serve who only stand and wait!"

. . . . . .

I saw you put that smoke away when I came to talk to you last Saturday! Good! Do it again. Business is business!

. . . . . .

Don't forget my advice of last week. It holds good still!

ADDITIONAL EXHIBITORS.

WITH reference to our table of exhibitors published on page 542 last week, the following firms whose names did not appear there have stands in the Hall. They were not included in the official list at the early date of going to press with our Exhibition Supplement last week:—

J. J. Griffin & Sons, Ltd. (252).
Harper Electric Piano Co., Ltd. (163).
Howard Asphalte Troughing Co., Ltd. (229).
Hudson Economiser Co. (253).
Hughes & Stirling.
Kearney High-Speed Railway Co. (245 and 250).
Leecla Watch Co. (205).
Mica Plate Co. (107 and 108).
Pearson Fire Alarm Co. (247).
J. W. Perkins (234).
Philipson & Co. (236 and 237).
A. W. Richardson (275).
Rothwell Patents Syndicate (241).
W. H. Roy & Co. (248A).
Secor Typewriter Co. (278).
H. C. Slingsby (246).
W. P. Theerman & Co. (in place of Arcalia Electrical Manufacturing Co.) (136).
A. G. Thornton, Ltd. (222).
Vulcan Boiler and General Insurance Co., Ltd. (223).

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CONTRACTS OPEN.

(*Continued from page 590.*)

Hungary.—The municipal authorities of Prazsmar, Hungary, are organising a competition for the best scheme for the establishment of a central electric lighting station in the town. A prize of 1,000 crowns is offered to the author of the selected scheme. The competition closes on the 31st inst.

Leeds.—October 14th. Materials for tramway construction for the Tramways Committee. See "Official Notices" to-day.

London.—October 13th. Six fuel economisers, 320 tubes each; three electrically-driven feed pumps, 9,000 gals. per hour each; and two 5,000-KW. horizontal steam turbo-generators, for the L.C.C. See "Official Notices" September 18th.

October 27th.—12 water-tube boilers with mechanical stokers, superheaters, &c., for the L.C.C. See "Official Notices" to-day.

Portsmouth—October 21st. Reconstruction of a turbo-generator for the Corporation. See "Official Notices" to-day.

Rochdale.—October 15th. Erection of overhead bare copper cable at the workhouse. See "Official Notices" to-day.

October 12th.—The Electricity Committee invites tenders for vertical steam feed pumps. See "Official Notices" to-day.

Spain.—October 10th. The municipal authorities of San Mateo (province of Castellon) are inviting tenders for the concession for the electric lighting of the town during a period of 10 years. Conditions may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de San Mateo (Castellon).

Twickenham.—October 14th. Electric lighting installation at the Isolation Hospital of the U.D.C. See "Official Notices" to-day.

War Office.—Stores, &c. See "Official Notices" September 25th.

CLOSED.

Australia.—SYDNEY (N.S.W.).—Postmaster-General. Zwicker, Tod & Co.—4,000 insulators, £167.

PERTH (W.A.).—Supply and Tender Board:—
Imperial Electric and Engineering Co.—One 4-H.P. electric motor, £29.
Faulding & Co.—Five tons chloride of calcium, £4 15s. per ton.

ADELAIDE (S.A.).—Postmaster-General:—
International Electric Co., London.—Twelve visual vibrating indicators, 9s. each; one lightning arrester board for 100 metallic circuits, £10 15s.; two carbon lightning arresters, each for 50 circuits, £6 15s. each.
Western Electric Co.—100 coin attachments, £1 0s. 3d. each; three 40-switch switchboards for 100 metallic lines, £41 7s. each; 40 one-lever two-way switches, 1s. 10d. each.
British Insulated and Helsby Cables, Ltd.—Two switchboards for 50 metallic circuits each, £30 10s. 3d. each; two ditto for 25 circuits each, £23 11s. 6d. each; two carbon lightning arresters, each for 25 metallic circuits, £5 2s. 6d. each.
J. Bartram & Son.—24 trunk line timers, 15s. 6d. each.
India-Rubber, Gutta-Percha and Telegraph Works Co.—6,000 cords, Meidinger line, £2 1s. 8d. per 1,000; 5,000 tubes, Meidinger line, £10 per 1,000; 9,000 zincs, Meidinger line, £29 8s. per 1,000; 1 ton crushed sal-ammoniac, £37.
George Wills & Co.—Six tons sulphate of magnesia, £5 15s. 1d. per ton.

Barking.—The U.D.C. has accepted the tender of Messrs. Anderson & Sons for installing the electric light at Creeksmouth schools.

Boggleshole Colliery.—Messrs. James Dunlop and Co., Ltd., have placed an order with Messrs. Johnson & Phillips, Ltd., for the supply and erection of shaft cables.

Bradford.—The tender of Messrs. J. W. Singer & Sons, Ltd., for special electric lighting fittings and installation for the extension of the Town Hall (£1,749) is recommended for acceptance by the City Council.

Bury (Lancs.).—The T.C. has accepted the tender of Messrs. John Musgrave & Sons, Ltd., of Bolton, for a Zoelly turbine direct coupled to a Siemens alternator, with air and circulating pumps made by Messrs. Chas. Walmsley & Co., Ltd., Bury.

Dublin.—The Lighting Committee has provisionally accepted the tender of the General Electric Co., Ltd., for the supply of electricity meters for 12 months; also the tender of Messrs. Babcock & Wilcox, at £6,423, for boiler plant and accessories.

Glasgow.—The Tramways Works and Stores Sub-Committee have recommended that the Corporation accept the offer of the British Thomson-Houston Co., Ltd., for three-phase motors and gearing for mechanical stokers and conveyors for Pinkston power station. The same committee has also recommended acceptance of the following offers:—
British Westinghouse Co.—Rotary converters, transformers and high-tension switchgear for new sub-station at Ruthergien.
British Thomson-Houston Co.—Low-tension switchgear for new sub-station at Ruthergien
Jas. M'Millan & Co.—Relays.
Key Engineering Co.—Air compressor.
British Electric Plant Co.—Storage battery and motor-generators.
Lahmeyer Electrical Co.—Copper bonds.
Tangyes, Ltd.—Wheel lathe.
Wm. Landell.—Patent step treads.
Consolidated Equipment and Engineering Co.—Phono trolley wire.

Hornsey.—The B.C. has accepted the tender of Messrs. Charrington, Sells, Dale & Co. for the supply of Brynteg Welsh coal, at £1 0s. 6d. per ton.

Hull.—The Tramways Committee of the T.C. on Friday accepted the following tenders:—
Siemens Bros.—Generating set at the tramway power station, £5,926 10s.
Amos & Smith.—Condensing plant, £895.
Hadfield's Steel Foundry Co.—Tramway rails, &c., £1,213.

Leeds.—The Corporation has accepted the tender of Mr. T. W. Matthews for the supply of 2,200 Osram lamps for the Town Hall and municipal buildings. It has been decided to purchase 70 magnets for brakes from the Electric Mechanical Brake and Engineering Co., at £11 10s. each.

Leyton.—The U.D.C. has accepted the following tenders for materials required for the electrical equipment of the portion of the tramway line in Lea Bridge Road within the area of the L.C.C.:—
F. Smith.—Trolley wire, £88.
Spencer, Ltd.—Poles, £224.
Dick, Kerr & Co.—County Council bases, &c., £71.
Turners & Manville.—Insulator bolts, £9 16s. 8d.
Brecknell, Munro & Rogers.—Span brackets, &c.
Dennis & Co.—Span wire, &c.
W. Wood & Co.—Hangers and ears.

The following tenders have also been accepted:—
General Electric Co.—Electrical accessories, asbestos and insulating material, armature repairing materials, cables and wires.
British Westinghouse Co.—Mica cones, controllers, cable connectors, switches, carbon brush-holders, &c.

Lochgelly.—The Lochgelly Iron and Coal Co., Ltd., have placed an order with Messrs. Johnson & Phillips, Ltd., for underground switchgear for their Lochgelly Pits.

London.—FULHAM.—The Electricity Committee has entered into contracts with the undermentioned firms for the supply of 7,000 tons of coal, to be delivered at the electricity works, Townmead Road, during the ensuing 12 months:—
Gillman & Co—3,000 tons "Mapperley Smitham," 10s. 4d. per ton.
Kaye, Son & Co.—2,000 tons "Mapperley Smitham," 10s. 4d. per ton; 2,000 tons "Beath Peas," 9s. 9d. per ton.

The total cost is not to exceed £3,558.

The contract for the electric lighting and three-phase power plant for the United Mills' Equipment Co., London, has been given to Messrs. Maxwell, Son & Co., of Dundee.

WOOLWICH.—The B.C. has received the following tenders for the supply of cable required for extensions:—

		Time for completion.
Western Electric Co. .. .. (accepted)	£1,450	6 weeks
Johnson & Phillips, Ltd.	1,468	7-8 ,,
W. T. Glover & Co.	1,471	8 ,,
W. T. Henley's Telegraph Works Co. ..	1,484	7 ,,
Siemens Bros. & Co.	1,489	8 ,,
Callender's Cable & Construction Co. ..	1,498	6 ,,
British Insulated & Helsby Cables, Ltd. ..	1,526	8 ,,
St. Helens Cable & Rubber Co.	1,535	8 ,,
Sun Electrical Co.	1,542	8 ,,

For 110 yards of three-core ·05 lead-sheathed and armoured cable recently required urgently to connect up existing applications and for stock purposes, the Western Electric Co.'s tender was also accepted.

Rotherham.—The Electric Light and Tramways Committee of the T.C. has accepted the tender of Jas. Cooper, at £127, for the foundations for a turbo-generator.

Salford.—The B.C. has accepted the tender of the British Insulated and Helsby Cables, Ltd., for feeder pillars.

Warrington.—The B. of G. has accepted the tender of Mr. Smith for the supply of electrical goods for three months.

Storage Battery Traction.—The Prussian-Hessian railways are installing storage battery cars for suburban traffic near Mainz. Each of the smaller cars will contain 180 cells, of 10 tons total weight, while each of the larger cars will contain 180 cells of 15 tons weight. The axles will be driven by means of two series motors in the usual way. The following estimate of cost is given:—For the generation of 200,000 KW.-hours with Diesel engines, the cost per KW.-hour including interest and amortisation is ·625d. No special attendance is assumed, since the motorman will attend to the charging of the batteries at the station. The consumption of 200,000 KW.-hours per year relates to a distance of 180,000 km. covered per year by the five cars, so that each car is assumed to travel 36,000 km. per year. The cost of maintenance of the storage batteries is assumed as 1d. per car-km. The total cost of operation is 4·375d. per car-km., including interest and amortisation. With the new cars which contain 100 or 110 passengers the total cost is estimated as 6·25d. per car-km., so that if the tickets are sold at ¼d. per km. the income will cover the expense even if only one-fourth of the seats are filled. The life of the positive plates is assumed as 120,000 km., that of the negative plates 80,000 km.—*Electrical World.*

CONTRACTORS' COLUMN.

[The following information is published in the interests of electrical contractors and others who are seeking for openings for new business. Considerable expense is incurred in the production of this column, and every care is taken to ensure that the information is new and accurate, but it will be understood that in a matter where so many correspondents are engaged, and where the amount of information to be handled is very large, this cannot always be guaranteed. If alleged inaccuracies are reported to the Editors, they will be fully investigated.]

ABERDEEN.—Additions to Holburn Street Schools (£1,000). Gall & Walker, builders. Conversion of the old theatre, Guild Street, into a variety music hall. Additions to fish-curing premises, for Garriock & Co.; G. J. Milne, architect. Additions to granite works, for W. Taggart, granite merchant; D. Hodge, architect. Dwelling houses, for J. Shirras, builder; dwelling houses in Polmuir Road; Sutherland & George, architects. Dwelling houses in Albury Road; D. & J. R. McMillan, architects.

ABRAM (near Wigan).—Slaughter houses, &c. F. Robinson.

ACCRINGTON.—Alterations at the electric tramway depôt. Town Council.

ALLERTON BYWATER (near Castleford).—Shops and houses, for J. Prince. Garside & Pennington, architects, Pontefract.

ALRESFORD (Hants).—Proposed Convalescent Home.

AMMANFORD.—Bank premises and two shops in Quay Street, for J. Phillips. A. S. Williams, architect, Llandilo.

BARNSTAPLE.—E.L. to be installed in St. Mary Magdalene Church.

BURTON-ON-HUMBER.—Alterations and additions to the Red Lion Hotel. Tennant & Collins, architects, Pontefract.

BATLEY.—Two electric fans for Batley Working Men's Club. Secretary, Working Men's Club, Batley.

BECKENHAM.—Additions to "Heathfield," Scott's Lane; M. Zimmerman. Four houses, Marlow Road; J. Hughes. Six houses, Clock House Road; F. D. Rodda.

BEXHILL.—Additions to Portland House, Dorset Road, for Moon & Garner; G. H. Gray, architect. Detached house, Sutherland Avenue, for W. White; G. E. Maynard, Ltd., architects. Gymnasium, Bedford House School, Cantelupe Road. Rev. G. F. Russell, owner and architect.

BEXLEY.—House, Freta Road, for J. Houghton.

BLACKBURN.—Houses, Cornelian Street, for John Cronshaw, builder, Lynwood Road; Albany Road, for J. J. Winterbottom; Grange Street, for J. Highton & Sons, builders, Bridgwater Street; Providence Street, for the Daisyfield Co-operative Society; Whalley New Road, for Wm. Penney; Mayflower Street, for Maxwell & Shaw; warehouse, Dewhurst Street, for J. Duckworth.

BLACKPOOL.—New villa residences, Marton Road, Marton. Clough and Pendlebury, Princess Street Saw Mills, builders, Blackpool.

BLAENGWYNFI.—New infant school. T. Mansel Franklen, clerk to the County Council, Westgate Street, Cardiff.

BOLTON.—Mission room, Well Street, for Rev. J. W. Broadbent; additions to premises, Rosamond Street, for the Co-operative Society. Proposed telephone exchange; Borough Engineer, Bolton. New place of amusement; Fenton Cross, entertainer, Bolton. Extensions to premises for Messrs. Crooks, cotton spinners; and Tootal, Broadhurst, Lee & Co., Sunnyside Mills.

BRACKLEY (Northants).—Operating room at the Cottage Hospital; mission room at Halse, for the Earl of Ellesmere.

BRADFORD.—New wheelwright's workshops in Bewland Street; H. Hardaker, architect, Ivegate Chambers, New Ivegate, Bradford. Extension of the cooking depôt at Green Lane School, for the Education Committee; City architect, Whitaker Buildings, Brewery Street, Bradford.

BRISTOL (Pilning).—Proposed alterations at the Almondbury Council School. Gloucestershire Education Committee.

(Bitton).—New Council School. Gloucestershire Education Committee.

BROMLEY.—Houses, Shawfield Park; W. J. Pampilon, architect, 92, Tweedy Road, Bromley. Houses, St. George's Road, for G. W. Hart.

BUXTON.—Alterations to London Road Inn, for Ind, Coope & Co.; G. E. Garlick, architect, Quadrant Chambers, Buxton.

CARDIFF.—Two houses, Cog Road, Sully. White & Britton, builders.

CHELMSFORD.—Two detached houses, Rainsford Road, for F. Cracknell; two pairs of flats, Trinity Road, for Wm. Rosser.

CHESTERFIELD.—Proposed new Church Institute at Brimington.

CHIPPENHAM.—Alterations to house at Kingston Langley, for Earl Cowley; alterations to the Cleeve, Corsham, for F. J. Chapman; houses, Ladyfield Estate, for Mr. Rogers.

CHIPSTEAD (Surrey).—House, Hazlewood Lane, for Walter Freeman, Fleet Street, London, E.C.

CHORLEY.—Villas, Gillibrand Walks, for Miss Clayton; 10 houses, Cowling Brow, for J. W. Lee.

CINDERFORD (Glos.).—New Higher Elementary School. R. S. Phillips, architect, Midland Bank Chambers, The Cross, Gloucester.

CLAYTON (near Manchester).—New Institutional Church. R. Parker, architect, Albert Square, Manchester.

CLECKHEATON.—Dual Secondary School and Technical Institute (£7,500). W. H. Thorp, architect, South Parade, Leeds.

COATBRIDGE.—Stock shed at the British Tube Works, for Stewarts and Lloyds, Ltd.

CORK.—Additional married soldiers' quarters at Cork Barracks. Director of Barrack Construction, Pall Mall, London, S.W.

CREWE.—Projected alterations at the Egerton Arms, Peter Walker & Sons workshops in Earle Street, J. F. Heath; proposed orphanage, Borough Engineer.

CRICCIETH (Carnarvonshire).—Bungalow residence for the Right Hon. Lloyd-George, M.P. Rowland Lloyd Jones, architect, Carnarvon.

DARLINGTON.—Houses, Ashcroft Road, for Clark & Moscrop; Milton Street, for W. Johnson & R. Pocklington; Milton Street, for J. E. Chilton; Mellard Street, for R. Blackett & Son, builders, 8, Paradise Terrace; Upper Victoria Street, for J. W. Watson; Langholm Crescent, for G. W. Davies; Lewes Road, for James Wallis. Additions and alterations to offices for the B. of G.; Hoskins and Brown, architects, Court Chambers, Darlington.

DARTFORD.—New church (Christ Church) (£2,735). W. F. Blay, Ltd., builders, Spital Street, Dartford.

DEAL.—Houses, London Road, Upper Deal, for Mrs. Cheston; Mill Road, for G. R. Cottew, builder, New Street, Deal; Albert Road, for E. Robinson.

DERBY.—New theatre in Beckett Well Lane.

DONCASTER.—New colliery at Carcroft, near Doncaster.

DORCHESTER.—Proposed Council school. Dorset County Education Committee.

DUDLEY.—New Primitive Methodist Church in Vicar Street.

DUNDEE.—Alterations on property at 20-24, St. Mary's Place, for T. B. Murray; cottages in Gedburgh Road, for McMillan & Matthew. Tenements and cottages for Corporation; J. Thomson, burgh engineer.

DUNFERMLINE.—New primary department at High School. H. & D. Barclay, architects.

DUNSTON.—New coal staiths and other developments. North-Eastern Railway Co.

EASTBOURNE.—Proposed alterations to the Sussex Hotel.

EBCHESTER (Co. Durham).—House at Low Westwood. R. Fenwick, Earsdon House, Ebchester, Co. Durham.

ECCLES.—E.L. wiring and fittings for the Town Yard buildings, for the T.C. workmen's dwellings, Corporation Road, for the T.C.; houses, Worsley Road, Winton, for Thos. Witton; Crawford Street, Monton, for Ludlow & Bannister; additions to the works of the Protector Lamp and Lighting Co., Ltd., Lansdowne Road, Monton; projected works, for the Auto-Machine Products Co.

EGREMONT (Cheshire).—Houses, Rivington Road, for J. J. Evans, Mostyn Avenue, West Kirby.

ELLESMERE PORT.—New works for the St. Helens Manufacturing Co.

ELTHAM.—Branch bank for the London and South-Western Banking Co. in High Street. Six houses, Dumbreek Road; J. J. Bassett, 121, Earlshall Road, Eltham.

EXETER.—Electric lighting of Emmanuel Church (tenders by October 13th). J. W. Burt, 3, Comrie Crescent, Queen's Road, Exeter.

EXMINSTER (near Exeter).—Attendants' cottages at the asylum, for the Devon C.C. (£1,500).

FARNBOROUGH (Hants).—Cottage hospital at Frimley, for the Frimley District Cottage Hospital Committee. H. R. & B. A. Poulter, architects, London Road, Camberley.

(Kent).—Bungalows, Standard Road, Downe. W. Cook, builder, Bromley Common.

FARNWORTH (Bolton).—Alterations at Grecian Mills.

FERRYHILL (Co. Durham).—New Primitive Methodist Church and schoo's.

FOLKESTONE.—Proposed Winter Garden on the sea front.

GILLINGHAM.—Repairs, &c., to the Vestry Hall, Church Street. J. W. Peachell, vestry clerk, Gillingham.

GLOSSOP.—New Conservative Club and shops, Norfolk Street. J. Eaton, Sons and Cantrell, architects, Stamford Street, Ashton-under-Lyne.

GOOLE.—Accumulator house, &c., at Swing Bridge, for the North-Eastern Railway Co. W. J. Cudworth, engineer to the company, York.

HARROGATE.—New Wesleyan Church and minister's house at Starbeck.

HAYES (Middlesex).—Iron hospital block at the Small-Pox Hospital, Yeading Lane, for the Uxbridge Joint Hospital Board. W. L. Ever, architect, 54, High Street, Uxbridge.

HAYDOCK (Lancs.).—New Church of St. Mark.

HECKINGTON (Lincs.).—Alterations and additions to house for the Misses Godson. J. Clare, architect, Sleaford.

HEMSWORTH.—Houses, South Kirby, for E. A. Mason; South Hiendley, for Mrs. A. Owram; South Elmsall, for Lyall & Taylor; Brierley, for E. Hoyland; parish room at Upton, for Miss Jones.

HENSINGHAM.—Seven houses. J. S. Stout, architect, 36, Lowther Street, Whitehaven.

HITCHIN.—Houses, Balmoral Road, for E. Smith; Storehouse Lane, for the Steam Laundry Co.; M. Foster & Co., builders. Additions to "Elmside," Chiltern Road; J. Willmott & Son, builders, 80, Walsworth Road, Hitchin.

HOLMES CHAPEL (Cheshire).—Proposed extensions to the Agricultural and Horticultural College, for the C.C. (£3,000).

HOLSWORTHY.—Extension of the Wesleyan Chapel, Chilsworthy.

HUDDERSFIELD.—Extensions at Bradley. Midland Railway Co.

HULL.—Houses, Newland, for J. E. Mallison; Westminster Avenue, for W. Finch; Reynoldson Street, for G. B. Cheeseman; Durham Street, for J. Wood; Ventnor Street and Exmouth Street, for G. T. Spruit; Garden Village, for the Garden Village, Ltd.; Blaydes Street, for F. Allon, builder, Clifton Street; Hessle Road, for F. J. Watts; Victoria Avenue, for G. Wardell; Whitworth Street, for J. T. Taylor; Essex Street, for A. Whincop; Aberdeen Street, for Mrs. L. Charles; East Park Avenue, for W. Finch; Devon Street, for Mrs. P. Smith; Anlaby Road, for J. H. Osborne, builder, 5, Hayes Avenue, Ella Street; Marlborough Avenue, for J. E. Wray; Estcourt Street, for F. Hornsey; Chapel, Holderness Road, for the Yorkshire Baptist Association; Methylating Works, Bankside, for Blundell, Spence & Co.; reconstruction of premises, Lowgate, for B. P. Mason & Co.; shop, Jameson Street, for G. Taylor. Infants' School in Craven Street; J. H. Hirst, city architect, Town Hall, Hull.

KING'S NORTON.—New schools, Stirchley (£4,173); W. A. Harvey, architect, 5, Bennett's Hill, Birmingham. Schools at Selly Park (£15,938); Wm. H. Ashford, architect, Birmingham.

LANCASTER.—Fourteen houses, in Sibsey Street; P. L. Dilworth, builder, Lancaster. Twelve houses in Connaught Road; Messrs. Hodgson & Bowker, builders, Lancaster. Twenty-two houses in Trafalgar Road; W. Mashiter, builder, Lancaster. Detached house, Scotforth Road; W. Hinton, Spring Bank, Lancaster.

LEATHERHEAD.—Proposed new school (£4,000). Urban District Council.

LEEDS.—Transformer chamber (overground) in East Street; H. Dickinson, manager of the Electricity Department, 1, Whitehall Street, Leeds. Extension to Library accommodation at Woodhouse; W. T. Lancashire, city engineer.

LEIGH (South Lancs.).—Probable alteration and extension of Charles Street Mill. G. R. Wright & Co., Bingley, Yorkshire.

LEYBURN (Yorks.).—Twenty-four houses. W. and T. R. Milburn, architects Sunderland.

LEYLAND (near Preston).—Extensive alterations to premises, for Messrs Jamieson, boot dealers, Preston.

LEYLAND (Lancs.).—Extensions for the Leyland and Birmingham Rubber Co.; conversion of premises into dwelling house, for T. Wilson.

LINCOLN.—Projected new Anglican Church for St. Swithin's parish.

LITTLE HULTON (near Bolton).—Proposed extensions. Suez Mill Co. Worsley Road.

LLANDAFF (Glam.).—New school for 250 scholars for the C.C. T. Mansel Franklen, County Council Offices, Cardiff. Six houses, Heathfield Road; Watts & Son, builders, Llandaff North.

LLANISHEN.—Additions to house, Station Road. Capt. J. Wilkie, Station Road, Llanishen.

LIVERPOOL.—Extension of Exchange Hotel. Lancashire and Yorkshire Railway Co.

LONDON (Lewisham, S.E.).—Three houses; W. J. Scudamore & Son, builders, 13, Manor Lane, S.E. Addition at "Kirklynton;" R. Jenner and Sons, builders. Mount Pleasant, Sydenham Hill Road, S.E.

(Wimbledon, S.W.).—Pavilion for Royal Wimbledon Golf Club. Alterations and additions to Wimbledon Town Golf Club House. Two houses, Dora Road; Boyton, Sons, & Trevor, surveyors, High Holborn, W.C. Shop and warehouse, Merton Road, for J. K. Skewes, draper, Broadway.

(Tooting, S.W.).—Alterations, &c., to Cemetery Church. E. Hoare, architect, c.o. The Bishop of Southwark, South Place, Kennington, S.E.

LONDON (Wandsworth, S.W.).—Additions at Windsor Works, Venn Street, Clapham, North; H. Somerford & Son, builders, 138, Manor Street, Clapham, S.W. Lodge at Gayton Lodge, Wimbledon Park Side, Southfields; Maple & Co., Ltd., Totienham Court Road, W. Alterations and additions at Messrs. de Never's Rubber Tyre Co.'s Works, Bendon Valley, Springfield; W. Harbrow, builder, South Bermondsey Station, S.E. Five houses, Pulborough Road; six houses, Granville Road, Southfields. Woodley Bros., Woodhouse, Wimbledon Road, Tooting Graveney, S.W.

(Chelsea, S.W.).—Addition to buildings in Hans Place. I. Cash, architect, 22, Surrey Street, Strand, W.C.

(Leytonstone, N.E.).—Alterations to Cowley Arms public house, High Road, for W. Darton, licensed victualler.

(Poplar, E.).—Motor garage at Glicksten's timber yard. Taylor Bros., builders, 45, Rothbury Road, Hackney, N.E.

(Leyton, N.E.).—Additions to workshop; F. J. Coxhead, builder, Bulmer Road, E. Sheds, stores, &c., at London Electric Wire Co.'s premises, Church Road; A. W. Hudson, architect, 87, Finsbury Pavement, E.C. Institute in connection with Christ Church; Mattock Bros., builders, Winkfield Road, Wood Green, N.

(Fulham, S.W.).—Office, North End Road, for Midland Railway Co. A. Wheatley, chief office, Midland Railway Co., Derby.

(Bromley, E.).—Additions to residency, 69, Freelands Road; Pearce Bros., builders, 87, Hawes Road, Bromley. New residence, St. George's Road, and motor shed; G. W. Hart, builder, Redington Road, N.W.

(Muswell Hill, N.).—Additions, 28, Grand Avenue; W. J. Collins, builder, 13, Firs Park, Hornsey, N. Alterations and additions, 10, Victoria Parade; D. A. Whitehead & Co., 10, Victoria Park, Hornsey, N.

(Highgate, N.).—Seventeen houses, Southwood Lawn Road. A. G. Shearing, 12, Fortress Road, N.W., surveyor.

(Hornsey, N.).—Laying out Northwood Estate. J. C. Hill, builder, 55, Glenmore Road, N.

(Stepney, E.).—Building, Christian Street; M. W. King & Son, surveyors, 6, Holborn Viaduct. Rebuilding houses, Duval Street; C. E. Salmon, architect, Bell Street, Reigate. Rebuilding houses, Jubilee Street; Watkins, Baylis & Chidson, solicitors, 11, Sackville Street, W.

(Kilburn, N.W.).—Baptist Church (£1,309). R. Argyle, architect, Alfred Street, Ripley, Derby.

(Brompton Road, S.W.).—Shop, on site of All Saints' School. C. H. Townsend, architect, 32, Great George Street, S.W.

(Plumstead).—Bakehouse, Plumstead Road; Church, Quick and Whincop, William Street, Woolwich. Church and presbytery, Abbey Grove; Williamson & J. H. Beart Foss, 27A, Sackville Street, Piccadilly, W. Rebuilding shop, Hudson Road; G. Blackler & Sons, builders, 33, Pattison Road, Plumstead. Alteration to "Falconwood," Shooter's Hill, for Baroness d'Erlanger; G. F. Dean, 9, South Molton Street, London, W.

(Woolwich).—Iron building for dining-room for Western Electric Co.; J. Grover & Sons, builders, Wilton Works, Islington, N. Rebuilding three houses; S. A. Douglass, 17, Tilse Road, Plumstead. Two houses, Elizabeth Street, North Woolwich; W. Harris, Steam Joinery Works, North Woolwich. Enlarging Maitland Cottage Sanatorium; W. F. D. Smith, M.P., chairman of Committee, 3, Grosvenor Place, S.W.

LUTON.—Houses, Westbourne Road, for Brown & Co.; Baker Street, for W. F. Mullett; Kenilworth Road, for T. Day; West Hill Road, for W. Smith; Reginald Street, for F. Chandler, builder, 78, Cromwell Road; Kenilworth Road, for C. H. White, builder, 72, Dunstable Road; Reginald Street, for A. Field; Round Green, for A. Mardle, builder, 18, Cowper Street; shop-residence, &c., Smart Street, for Geo. Kingham, builder, 106, Old Bedford Road; studio, 20, Castle Street, for J. George; additions to premises, George Street, for Liptons, Ltd. Public library; S. E. L. Fox, borough surveyor.

LYDBROOK (Glos.).—New County Schools (£3,412). Wm. Crane, Ltd., builders, Nottingham.

MALTON.—New post office in Wheelgate.

MANCHESTER.—Alterations to shops in John Dalton Street; Peace and Norquoy, contractors, New Islington Works, Manchester. Developments at the Adelphi, Salford; Secretary, Bleachers' Association, Manchester. Alterations to premises in Deansgate; F. D. Narvell, cycle factor, Stretford Road, Manchester. Relighting scheme at St. Paul's Church, Bennett Street. Stables, &c., at the refuse destructor, Chorlton-cum-Hardy, for the T.C.; surveyor, Town Hall, West Didsbury, Manchester.

(Prestwich).—Additional school premises for teaching domestic subjects. Secretary, Prestwich Education Committee.

MARGATE.—Pavilion and winter gardens on the Kursaal site, for the T.C. Eighteen houses, Westcliffe Road; G. E. Burrows, architect, 8, Cecil Street, Margate. Motor garage, Cecil Square, for Blunden & Shadbolt. Proposed new Rob Roy Home at Cliftonville, for the Ragged School Union, 32, John Street, Theobald's Road, London, W.C.

MELKSHAM.—New Wesleyan Church at Broughton Gifford. A. E. Bush, architect, Melksham.

METHLIC (Aberdeenshire).—Beaton Public Hall, Methlic. J. Cobban, architect, Haddo House, Aberdeen.

MIRFIELD (Yorks.).—New Sunday Schools in connection with Knowle Wesleyan Church (£1,600).

NANTWICH.—Probable re-erection (after fire) of premises for Chester Bros., grocers.

NATLAND (near Kendal).—New church (£4,500), for Rev. C. J. Miller, vicar. Austin & Paley, architects, Lancaster.

NEWCASTLE.—Important suite of offices, corner of Mosley Street and Pilgrim Street, for the Alliance Assurance Co. Newcombe and Newcombe, architects, Pilgrim Street, Newcastle.

NORWICH.—Secondary school, Eaton Road, and alterations to existing buildings. C. J. Brown, architect, Cathedral Office, The Close, Norwich.

NOTTINGHAM.—Alterations to chemical and physical laboratories, and conversion of gymnasium into chemical laboratory, at High Pavement Secondary School. F. B. Lewis, City Architect, Guildhall, Nottingham.

OLDBURY.—Houses, Galton Road, for C. Wilmot; Galton Road, for Humphrey and Sanson.

OLDHAM.—Thirty-eight houses, Hollin Hall Estate, for the Equitable Co-operative Society; F. Thorpe, architect, 7, Cliff Street, Oldham. New Mormon Tabernacle; Elder James H. Platt, Oldham.

ORRELL (near Wigan).—New elementary school. County architect, Preston.

OTLEY.—Important post office extension. Post Office Works Department, Westminster. Warehouse in North Street for W. Sinclair & Sons, Ltd., manufacturing stationers.

PERTH.—Storerooms for J. Brown, merchant, 44, Long Causeway, Perth.

PETERBOROUGH.—New schools, Millfield; Townsend & Fordham, architects. New schools, West Town; S. Dodson, architect.

PLYMOUTH.—Horse slaughter house at Prince Rock, for T.C. Jas. Paton, Borough Engineer and Surveyor, Municipal Offices, Plymouth.

POCKLINGTON.—Houses, Monkhouse Road, Great Ayton, for Poole Bros., Middlesbrough; Dent Drive, Great Ayton, for T. Pearson; West Street, Yarm, for W. Doughty.

PONTEFRACT.—Stables, &c., for J. G. Lyon, J.P. Tennant & Collins, architects, Pontefract.

PRESCOT.—New Wesleyan Church.

PRESTON (Whittingham).—Annexe on the Asylum Estate (700 inmates). L. Cotman, Law Clerk to the Committee of Visitors for Whittingham Asylum, 8, Lune Street, Preston.

RAYLEIGH (Essex).—New County School (£2,705). F. & A. Willmott, builders, Ilford.

REIGATE.—Additions to Bures Manor, Leigh, for E. P. Charrington.

RETFORD.—Alterations and additions to the premises of the Nottingham and Notts Banking Co.

ROCHDALE.—Billiard hall for the Temperance Billiard Halls Co., Pendleton. R. Partington & Son, Middleton, & Young, Tinker & Young, Manchester, builders.

ROTHERHAM.—New school at South Grove (£12,000); D. B. Jenkinson, architect, "Holmesfield," Kimberworth, Rotherham. Two semi-detached houses, Ewers Road, for John Jones; four semi-detached houses, Pitt Street, for Wm. Charles; new topping shop and engine house, at Rother Iron Works, Fullerton Road, for Owen & Dyson; two semi-detached dwelling houses at Kimberworth, for T. Hill.

RUGBY.—Extensive alterations and additions to premises of A. G. Chamberlain & Co., chemists, 3, Market Place.

ST. HELEN'S (Isle of Wight).—New Vicarage. H. A. Coombes, builder, St. Helen's (I.W.).

SEAHAM.—New premises for the Seamen's Mission (£1,300). John Clark and Son, builders, Ryhope.

SEATON BURN (Northumberland).—New Presbyterian Hall (£663).

SEDGEFIELD (Ferry Hill).—Alterations and additions to premises in Front Street. T. W. Thubron, Front Street, Sedgefield.

SHEEPBRIDGE.—New collieries and by-product works (£70,000). Sheepbridge Coal and Iron Co., Ltd.

SHEFFIELD.—Reconstruction and additions to the Meersbrook Tannery Estate, Heeley; Empsell & Clarkson, architects, Exchange Buildings, Bradford. House, Fosdale Road; Mr. Waddington, builder.

SHERBORNE.—Primitive Methodist Chapel at Bishop Caundle.

SHIPLEY.—House, North Bank Road, for Mr. Armstrong.

SLEAFORD.—Extensions to the steam laundry. H. W. Benstead & Son, builders.

SOUTHPORT.—New Variety Theatre, to be lit by electricity. G. E. Tonge, Lord Street, Southport, and H. Armond Turner, Lloyd Street, Manchester, joint architects.

SOUTH SHIELDS.—New bank and three shops with suites of offices over, for North-Eastern Banking Co., Ltd., at corner Fowler Street and King Street. J. H. Morton, architect, King Street, South Shields.

SPENNYMOOR.—Houses, Merrington Lane, for James Savage; Ruby Terrace, for W. S. Gill; warehouse, for the Tudhoe Colliery Co-operative Society.

STEWARTSTOWN (Co. Tyrone).—Presbyterian Church at Brigh. Young and Mackenzie, architects, Scottish Provident Buildings, Belfast.

STOKE.—Dwelling house, All Saints' Road; Mrs. E. Powell. Nine houses, Egerton Road, Hartshill; Jones & Hilton. Alterations to shop premises, High Street; W. Jackson.

STRATFORD-ON-AVON.—House, Claverdon, for J. Douglas.

SUNDERLAND.—New St. Gabriel's Church (seat 900); C. A. Clayton Green, architect, Sunderland. Children's Hospital in Durham Road (£20,000). W. and T. R. Milburn, architects, Fawcett Street, Sunderland; Joseph Huntley, builder, Sunderland.

SUTTON COLDFIELD.—Extension of Four Oaks Wesleyan Chapel, and new Sunday Schools (£5,000).

SUTTON-IN-ASHFIELD.—New higher school and cookery, laundry, and manual instruction centre (£6,500). Notts Education Committee.

TUNBRIDGE WELLS.—Rebuilding of premises, High Street, for Lancasters, Ltd., cabinet makers.

TUNSTALL.—Proposed wiring of the Museum for the E.L.

UPPINGHAM.—Houses, North Street, for J. Dalby & Sons.

WALKDEN.—Town Hall and Public Offices in Walkden Road (£9,000 or £10,000).

WALTON-ON-THE-HILL (Surrey).—Houses, Waterhouse Lane, Kingswood, for Mr. Watson, Adam Street, London, W.C.; Walton Heath, Kingswood, for F. H. Hamilton, Chester Terrace, Regent's Park, London.

WARCOP (Westmoreland).—Extensions to Warcop Hall for J. A. Wild. Stephen Shaw, architect, Kendal.

WATFORD.—House, Burfield Road, Chorleywood, for C. T. Burke.

WARRINGTON.—Development of estate by the Warrington Garden Suburbs, Ltd., provision for 240 houses. A. & J. Soutar, architects, Wandsworth, London, S.W.; F. W. Wright, builder, Latchford, Warrington.

WENSLEYDALE (Yorks.).—Developments at brewery. Messrs. Plews.

WESTBURY (Wilts.).—Four pairs of houses at Dilton Marsh, for the Westbury and Whorwellsdown R.D.C. G. Stanley, architect, Market House, Trowbridge.

WELLINGBOROUGH.—Conversion of premises, Pebble Lane, into offices for the U.D.C.

WHITBY.—Pair of houses in Ruswarp Bank; John Porritt, builder. Bungalow on the Asp Farm, Stainsacre, and summer residence for I. T. Jackson, J.P., Ilkley; Geo. S. French, architect, Bank Chambers, Whitby.

WHITCHURCH (Cardiff).—Two houses, Church Road; J. Kitto, builder, Whitchurch. Two houses, Alfreda Road; F. & W. Kitto, builders, Whitchurch. Seven houses, Alfreda Road; F. & W. Kitto. Three houses, Philog Road; J. Lewis, builder, Whitchurch.

WICK.—Proposed new slaughter house. Mr. Bruce, Town Clerk, Wick.

WIGAN.—E.L. installation in St. Thomas's Church. Rev. R. Tebbs, vicar. Developments at collieries; Moss Hall Colliery Co. Developments at Radcliffe, by the Brynn Hall Colliery Co., Ltd., Wigan.

WINDSOR.—Villas at New Road, Clewer, for C. H. Pither.

WINCHESTER.—Rebuilding premises, High Street, for the International Stores, Mitre Square, London; rebuilding (after fire) of the Lion Brewery premises.

WIRRAL.—Workmen's houses, workshops, mortuary, &c., for the B.G. John H. Davies & Sons, architects, Chester.

WOKING.—New church at Brookwood.

WOLVERHAMPTON.—Secondary school for girls; Mr. Hutchings, architect, Stafford. Elementary school; Mr. Fleming, architect, Wolverhampton.

WOODHOUSE (near Sheffield).—Manse; J. Totty, architect, Moorgate Street, Rotherham.

WORCESTER.—Proposed hop warehouse extension. Alderman Caldicott, Chairman of the Worcester Hop Market Guardians.

WORKINGTON (Cumberland).—Developments and restarting works. Cammell, Laird & Co., engineers.

WORTHING.—Houses, Salisbury Road, for J. Adams; Pembury Road, Broadwater, for J. H. Hagger; Rowlands Road, Hayward & Co.; Mill Road, G. Baker; Grand Avenue, Hayward & Co.; Upper Queen Street, for T. E. Sparkes; Clifton Road, for E. King; Cowper Road, for E. Child.

WRENBURY (Cheshire).—New works for the Trufood Co.

WREXHAM.—New premises, High Street, for the North and South Wales Bank.

FORTHCOMING EVENTS.

Saturday, October 10th.—At 3 p.m. Liverpool and District Electrical Association. Visit to Mersey Dock and Harbour Board's new offices, Pier Head, Liverpool.

At 2 p.m. N. of E. Institute of Mining and Mechanical Engineers. General meeting at the Wood Memorial Hall. Amongst other papers, one on "The 'Bold' Box-Controller and Box-Switch" will be read by Mr. J. G. Thompson.

At 7.30 p.m. At the Colonnade Hotel, Birmingham. Birmingham and District Electric Club. Opening meeting. Smoking concert.

Monday, October 12th.—At 8 p.m. Institution of Mechanical Engineers (Graduates' Association). Paper on "Steam Engine and Boiler Trials," by Mr. W. Inchley.

Tuesday, October 13th.—At 8 p.m. At the Common Hall, Hackins Hey, Liverpool. Liverpool and District Electrical Association. Presidential address by Mr. H. E. O'Brien.

Wednesday, October 14th.—At 8 p.m. St. Bride's Institute, London, E.C. Association of Engineers-in-Charge. Presidential address on "Smoke," by Mr. James Swinburne, F.R.S.

Thursday, October 15th.—At 8 p.m. Rugby Engineering Society. Presidential Address by Mr. A. P. Bennett.

Friday, October 16th.—At 8 p.m. At the Institution House. Institution of Mechanical Engineers. Paper on "Repairs, Renewals, Deterioration and Depreciation of Workshop Plant and Machinery," by Mr. J. E. Darbishire.

Saturday, October 17th.—Meeting of Electrical Contractors at the Manchester Electrical Exhibition.

THE ELECTRICAL ENGINEERS
(LONDON DIVISION).

The following orders are issued:—

Monday, October 12th.—"A" Company. Technical drill, 7 to 10 p.m.
Tuesday, October 13th.—"B" Company. Technical drill, 7 to 10 p.m.
Thursday, October 15th.—"C" Company. Technical drill, 7 to 10 p.m.
Friday, October 16th.—"D" Company. Technical drill, 7 to 10 p.m.
Tuesday, October 13th, and every Tuesday until further orders.—Medical inspection for recruits, 6 to 7.30 p.m.
Members of the Corps are requested to sign the new special service section forms.

(Signed) J. H. S. Phillips,
Capt. and Acting Adjutant.

NOTES.

The Contractors' Exhibition Gathering.—We are asked by Mr. R. Robson, the hon. secretary to the Electrical Contractors' Association (Inc.), Northern Section, to state that any electrical contractor not in the Association, by writing to Mr. Shaw, of 10 and 16, Warren Street, Stockport, hon. secretary of the Manchester Branch, or to Mr. Robson, will be supplied with a ticket admitting him to the Exhibition to attend the Propagandist Meeting, which takes place on Saturday, October 17th, at 11 a.m.

Manchester Exhibition.—In the additional list of exhibitors appearing in our Special Exhibition Supplement this week, we have inadvertently omitted the name of Messrs. D. H. Bonnella & Son, Ltd., who are exhibiting at Stand No. 248 a large variety of electrical manufactures, such as bells, switches, switch-covers, Cooper's illuminating table-cloth, Ivoride fittings, &c. The following should also have been included:—

Auto-Stoker Co. (32, 33).
Automatic Machine Delivery Co., Ltd. (255, 256).
Bell Rock Belting Co. (270).
Bradford & Co. (285, 286).
Brayshaw, S. H. (259, 260).

Institution and Lecture Notes.—Society of Engineers.—A paper on "The History of Mechanical Traction on Tramways and Roads," was read by H. Conradi, A.S.E., on October 5th. Reviewing the different methods of traction on tramways and common roads, the writer maintained that steam tramway traction, properly conducted, seemed still to be capable of holding its own against electric and motor-omnibus traction, under the same conditions and if the same facilities were given.

Rugby Engineering Society.—The programme for Session 1908-9 includes the following papers:—

"Incandescent Electric Lamps," by Mr. F. Findlay.
"The Exhaust Steam Turbine," by Mr. R. F. Halliwell.
"Electric Railways," by Mr. F. W. Carter.
"The Propulsion of Ships," by Mr. G. M. Brown.

Iron and Steel Institute.—Several important papers were read at the Conference last week; we shall deal with them in later issues.

Electrical Football League.—The following League match will take place on Saturday (to-morrow) on the Guards' Polo Ground, Southfields:—County of London Electric *v.* Metropolitan Electric. Kick off at 3.30 p.m.

The Gardiner Electric Railway Signalling System.—On Wednesday last we were privileged to inspect an elaborate working model of the new system of signalling devised by Capt. A. Gardiner, R.E., Executive Engineer, Indian State Railways, and to receive a detailed explanation of its working from the inventor. Time and space limitations prevent us at this time from giving full particulars of the system, which, indeed, can be best studied with the model before one; but the following are its main features:—

The system makes use of a track circuit, one or both rails being provided with an insulating joint at suitable intervals—say, ½ mile. A continuous contact rail of light section is carried on insulators at the side of, and somewhat above, the running track, and is interrupted at the section joints. The track circuit is energised by a separate track battery, and actuates relays which close the circuit of a local battery in each section, when a train is on the line or when the circuit is completed by other means. One pole of the local circuit is connected with the contact rail, the other with earth or the negative track rail, and when a locomotive is on the track the local circuit is completed by contact shoes through the apparatus in the cab. An essential point in the system is that the interruption of any circuit gives the danger or stop signal; thus, when the contact rail is dead, a locomotive is forbidden to proceed over the corresponding section.

The live or dead condition of the contact rail gives the "Line clear" or "Line blocked" signal continuously in the cab of a locomotive in the section. But if a driver were by accident or design to run out of such a section into a section in which there was an obstruction, such as a train on the line or open gates at a level crossing, he would lose this indication, and would be free to get into trouble. To prevent this, an important innovation has been made by Captain Gardiner. Near the end of each section the contact rail is ramped to a higher level for a short distance, thus raising the shoe as it passes over, and actuating contacts on the locomotive which give a separate "Danger" signal, which remains, compelling attention to the fact that the driver is running in a blocked section. Provision is made for combining with the stop signal means for shutting off steam and putting on the brakes, besides sounding loud horn, bell or whistle signals in the cab.

Short ramped sections of contact rail between the track rails, with corresponding shoes on the locomotive, provide a means of giving special signals to the driver, such as "reduce speed" for running into dead ends or round curves, or an indication as to which of a set of branching lines the points are set for at junctions, stations, &c. Provision is also made for interlocking the cab signals with the existing semaphore signals (though the inventor intends the system to be complete and adequate without any semaphores), points, &c., so that it is impossible to bring about disaster except by deliberate disobedience to the signals. In fact, his principle is to make action on the part of the driver necessary before a signal can be disobeyed, instead of action being necessary before a signal can be obeyed. When the train has been automatically stopped, the driver can always regain control and start again in due course. All contingencies seem to have been provided for by the inventor, including the application of the system to single-line working, and so far as judgment can be based upon a working model, the operation of the system is perfect; intentional obstructions and mistakes of all kinds in the manipulation of the points, signals, &c., are invariably detected by the devices employed in time to prevent disaster. Practical experience on actual railways is, of course, the sole reliable means of determining the merits of such a system, and as many railway men have already inspected it, we hope that an opportunity will be found to put the system to the trial. The model is exhibited at the offices of the Accumulator Industries, Ltd., No. 4, White Street, E.C., and is well worth a visit.

Electric Shock Fatality.—On Saturday last an inquest was held into the death of William Randle (25), who was killed by coming into contact with an electric wire while at work at Messrs. Stanley's colliery at Stockingford on September 30th. Alfred Challis said that there was an electric wire for giving signals, and also two cables which supplied the current for a pump. On the night of the accident he saw a flash at one of the bells. Later he saw Randle examining the bell with a candle, and hearing him exclaim, "Oh dear," looked round and saw him fixed against the wire. Witness and another man at once went to his assistance They tried artificial respiration, but failed to bring him round.—Thomas Moss, electrician of the colliery, stated that he examined the wires after the accident and found the bottom part of the spring of the bell had been burnt away. He also found, further down the hill, that there had been a contact between the cable and the signal wires. It seemed as if the cable had been bruised. He thought a piece of rock had fallen upon the wire and torn away the insulation from the cable, thus bringing the cable and wire in contact.—Dr. Nason said the condition of Randle was consistent with death from electric shock. The jury returned a verdict of "Accidental death," and recommended that thicker insulation be used on the electric cables in the pit.

International Electro-technical Commission.—The first meeting of the Council of the Commission, to which we have several times referred, is to be held on Monday, the 19th inst., at the new home of the Institution of Electrical Engineers, the Medical Examination Hall, Victoria Embankment. Delegates are coming from several different countries, and they are to be welcomed by the Rt. Hon. A. J. Balfour, M.P. There are at present committees in nine of the principal countries which are officially constituted and in proper working order, and Committees will shortly be formed in several other countries. One of the chief matters to be discussed is the election of the new President to take the place of the late Lord Kelvin, and of Mons. Mascart, the eminent French scientist, who was to have been elected President. There is very little doubt that Prof. Elihu

Thomson, of America, will be unanimously elected President of the Commission. Several matters, including the system upon which the glossary of terms is to be drawn up, a provisional standard of light, and the question of the metric system as affecting the work of the Commission, are to be carefully considered, and a short account of the deliberations of the Council will be published later. It is hoped that the Conference will arrive at an agreement as to the practical realisation of the ohm, ampere and volt, and as to the specifications for setting up the mercury ohm, the silver voltameter, and the cadmium cell—all of which questions have engaged the serious attention of our National Physical Laboratory during recent years, with results probably unsurpassed by those of any other nation. There will be an official banquet, a lunch with the Lord Mayor, and excursions to the Cavendish Laboratory, Cambridge, and the National Physical Laboratory. The delegates will also dine with the Dynamicables, and are invited to the annual dinner of the Institution of Electrical Engineers.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—MR. HORACE BOOT, consulting engineer to the Chichester Electric Light and Power Co., Ltd., has appointed MR. R. V. WEARE, late of the North Metropolitan Electric Power Supply Co., to be his representative in Chichester as clerk-of-works.

Can any good thing come out of Shoreditch? By no means the most aristocratic neighbourhood, with no exhilarating atmosphere, with a big gas works near by, and with some of the most poverty-stricken by-ways of London. Yet the electrical engineers whose duties take them there in the service of the Borough Council's electricity department rise quite superior to their depressing environment, and occasionally display a heroism which sets an example to the seething masses of humanity thereabout. One such event was the subject of an interesting little ceremony which took place at the Committee Room of the Electricity Works in Whiston Street the other day, when MR. A. LANE, an employé of the department, was presented with the parchment certificate of the Royal Humane Society for rescuing a boy from drowning in June last. Councillor Bibby, chairman of the Lighting Committee, made the presentation, Mr. Lane being introduced by Mr. C. Newton Russell, the borough electrical engineer. The certificate was framed by the station staff. This is the second occasion on which a member of the Shoreditch staff has saved child-life, the other rescuer being Mr. J. Kitchen.

On Monday evening (September 28th) a smoking concert was held at the Pigeons Hotel, Romford Road, by the members of the West Ham electricity staff. The concert was organised by Mr. W. H. Collins. During the interval Mr. Seabrook, on behalf of the members of the staff, presented an eight-day marble clock, suitably inscribed, to MR. F. FARNDON, assistant sales manager, in connection with his recent marriage. The prizes were afterwards presented to the successful competitors in the sports held at Broxbourne in July last. Mr. Seabrook congratulated the department generally on its interest in healthy sport.

According to the *British and South African Export Gazette*, MR. F. C. STEPHENS, the city electrical engineer of Johannesburg, will shortly be visiting England in connection with the fight before the Courts concerning the rejected gas plant.

We learn that a tug-of-war team, selected from the West Ham Corporation electricity staff of the generating station, Canning Town, is to compete in the great series of tug-of-war contests that will be "tugged" in the Stadium of the Franco-British Exhibition to-morrow, October 10th. The following appear in the list of the team from the generating station:—Messrs. Mackenzie, Crane, Sheehan, Bowles, Saunders, Harris, Brown and Horn. Mr. G. Lloyd Jones, the resident engineer at the generating station, Canning Town, has acted as coach.

The Walthamstow Urban District Council has resolved that MR. W. H. TAYLOR be in future designated assistant electrical engineer, and that during the absence of the electrical engineer, Mr. Taylor is to be in charge of the department.

The annual dinner of the Bury electricity works staff was held on Wednesday night last week, MR. S. J. WATSON, the electrical engineer, presiding.

MR. E. E. BENHAM is resigning his position with the Cleveland and Durham Electric Power, Ltd., in order to take up an appointment under the Admiralty at Devonport Dockyard.

The resignation of Mr. J. A. Jeckell, manager of the Coventry Corporation Electricity Works, which had been accepted by the Electric Light Committee, came before the City Council on Tuesday, when the resignation was notified in a report from the Committee. A letter addressed to the Mayor by Mr. Jeckell was read by the Town Clerk, as follows:—

"To the Mayor, Aldermen, and Councillors of the City of Coventry. Dear Sirs,—Regarding my resignation of my position which I sent to the Town Clerk, I desire to withdraw this on the grounds mentioned in this letter, and would ask the Council to permit a thorough investigation into the charges made with regard to the coal contracts of this department. I venture to ask your indulgence on this matter on the following grounds:—(1) Some very important evidence has reached me since my resignation was sent in. This evidence the Committee had not before them, nor was I in possession of the same when I submitted my resignation. The decision of the Committee was come to on the ground that a certain coal contract had been extended without sanction, whereas I find, on inquiry at the colliery company, that it had never been extended, and that, therefore, the complaint was groundless. I attach a copy of the letter, and the colliery company will be prepared to prove the statement to the satisfaction of the Council. (2) The Town Clerk read at the meeting a long written statement fully prepared which I had never previously seen, and which I had no opportunity of considering and answering. Under these circumstances I venture to think it was quite impossible for me to place in a clear manner before the Committee all the evidence which it was desirable that they should hear before arriving at any decision on the matter. (3) The postponement of this matter cannot in any way be prejudicial to the ratepayers. I further venture to think that the work which I have been able to accomplish, with the assistance of my Committee, justifies me in asking for your indulgence. As you doubtless know, the undertaking originally made a loss which had to be made good by the ratepayers of the town. This loss was made from the first year the undertaking started, and increased to £2,250 during the year previous to my taking over the management. Since I took over the management of this undertaking the financial position has steadily improved, until last year I was able to show a net profit, after paying all charges of any kind whatsoever, of £5,647, and instead of taking money from the ratepayers' pockets the undertaking is contributing to the rates and at the same time paying for a great deal of useless plant installed in the earlier days. Again, it is rarely that local authorities are allowed leave by Parliament to supply current in areas not belonging to these local authorities, and yet you will remember that last year you obtained this consent from Parliament though you were most strenuously opposed. Lastly, I would ask you to bear in mind the extremely flattering testimonial which I personally received from the financial electrical expert of the Local Government Board, a testimonial which had been granted, as far as I know, to no other electrical engineer in the United Kingdom, nor am I aware that any L.A. official has been the recipient of a similar testimonial. Bearing these things in mind, I ask to withdraw my resignation pending a thorough investigation into the charges that have been made.—I am, gentlemen, your obedient servant, JOS. A. JECKELL."

The following is a copy of the letter referred to from the Colliery Co.:—

"Exhall Colliery and Brickworks, Ltd., Exhall Colliery, Bedworth, September 29th, 1908. J. A. Jeckell, Esq., Corporation Electricity Works, Coventry. Dear Sir.—In reply to your inquiry of this date with reference to your letter to us of September 4th, 1907, respecting suggested extension of our contract for D.S. nuts from May 1st, 1907, to April 30th, 1908, we beg to say that this suggested extension of the contract to September 30th, 1908, was left in abeyance and not completed. At the end of April, 1908, a considerable amount of the coal purchased had not been taken, and what has been supplied from this time forward has been on account of the said arrears of the original contract.—Yours truly, A. LOLE, Secretary, the Exhall Colliery and Brickworks, Ltd."

After considerable discussion the Council declined to accept a proposition that Mr. Jeckell's letter be referred to the Committee for the position to be reconsidered, and the Electric Light Committee were authorised to consider the appointment of a successor.

General.—MR. JOHN D. MACKENZIE has recently severed his connection with the Tayler Smith Co., of Edinburgh and Glasgow, with whom he was acting as manager of the latter branch. The Tayler Smith Co. has been absorbed in the amalgamation of the De Laitte Gas and Elwell-Smith Safety Gas Companies, under the new name of Safety Light, Ltd.

MR. R. M. NEILSON has severed his connection with Messrs. Richardsons, Westgarth & Co., Ltd., Hartlepool, and has opened an office as consulting engineer and chartered patent agent, at 45, Hope Street, Glasgow.

The *Times* announces that the President of the Board of Trade has appointed MR. PERCY ASHLEY to be Secretary to the Advisory Committee on Commercial Intelligence, in succession to Mr. U. F. Wintour, who has been appointed Officer-in-Charge of the Exhibitions Branch of the Board.

A number of the employés of Messrs. Nicoll, electricians, Dundee, celebrated the completion of the fitting up of a new installation at Messrs. John Shields & Co.'s works at Perth, by a social meeting Mr. Wm. Smith was in the chair. In the course of the evening MR. JAMES CAINE, who has received an appointment in the South, was presented with a small token of esteem from his fellow workers.

Obituary.—BENNETT H. BROUGH.—Everyone of our readers will learn with sincere regret of the death of the secretary of the Iron and Steel Institute, which occurred last Saturday at a private hospital in Newcastle-on-Tyne. The deceased gentleman was taken ill after the meetings of the Institute at Middlesbrough last week, and he was operated upon on Friday. He was only 48 years of age.

SIR GEORGE LIVESEY.—"His whole life was devoted to gas-making," says the *Times* in its obituary of the late Sir George Livesey. That fact alone would not justify our including a note of his decease in the deaths' column of an electrical journal. Of more general interest to our readers have been his efforts at establishing profit-sharing and co-partnership between the shareholders and employés of the South Metropolitan Gas Co., with which he became connected at the age of 14 in 1848. He was in his 74th year. He was held in the most affectionate regard and esteem by all employés.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Mountain & Gibson, Ltd. (85,036).—Issue on August 25th of £200 and on September 11th of £5,000 debentures, part of series of which particulars have already been filed.

United Electric Tramways of Monte Video, Ltd. (80,456).—This company's annual return was filed on August 4th, when 35,250 preference and 33,600 ordinary shares had been taken up out of a nominal capital of £800,000, in 40,000 preference and 40,000 ordinary shares of £10 each. £70 has been received, and £688,430 is considered as paid on 35,243 preference and 33,600 ordinary. Mortgages and charges: £800,000.

Gent & Co., Ltd. (78,797).—A statement of the total amount outstanding on July 1st in respect of mortgages and charges created prior to that date and not required to be registered under Sec. 14 of the Companies' Act, 1900, has been filed pursuant to Sec. 12 of the Companies' Act, 1907. Particulars: Mortgage dated March 22nd, 1901, securing £2,000.

Electric Light, Power and Hiring Co., Ltd. (Haslingden) (72,303).—A statement of the total amount outstanding on July 1st in respect of mortgages and charges created prior to that date and not required to be registered under Sec. 14 of the Companies' Act, 1900, has been filed pursuant to Sec. 12 of the Companies' Act, 1907. Particulars: Deposit of deeds in 1906, securing £11,899 12s. 9d.

Immisch Launch and Boat Co., Ltd. (London) (82,454).—A statement of the total amount outstanding on July 1st in respect of mortgages and charges created prior to that date and not required to be registered under Sec. 14 of the Companies' Act, 1900, has been filed pursuant to Sec. 12 of the Companies' Act, 1907. Particulars: Mortgage dated 1907, securing £800.

Amalgamated Radio Telegraph Co., Ltd. (90,129).—A debenture dated September 11th, 1908, to secure £350, and further advances, charged on the company's undertaking and property, present and future, including uncalled capital, has been registered. Holders: H. Malpas and Mrs. M. M. Malpas, 46, Halsey Street, Chelsea.

Bradford Electrical Engineering Co., Ltd. (95,462).—A debenture dated September 17th, 1908, to secure £100, charged on the company's undertaking and property, present and future, including uncalled capital, has been registered. Holder: J. Garnett, 40, St. Paul's Road, Bradford.

CITY NOTES.

Yorkshire Electric Power Co.

The half-yearly meeting of this company was held on September 29th, at Leeds. Mr. A. G. Lupton presided, and in moving the adoption of the report, he said that the receipts for the six months amounted to £8,698, compared with £7,293 for the previous half-year. Compared with the corresponding half-year of 1907, they showed an increase of 85 per cent. After paying mortgage interest, there was for the first time a profit on the net revenue account amounting to £363, compared with a loss of £1,211 for the corresponding period of 1907. Since the report was issued there had been further applications for the new capital, of which £32,805 had now been taken up out of the total of £45,000. According to the report published in the *Yorkshire Daily Post*, the chairman said that the mains in the Barnsley direction were being laid, and would be in use by the end of October. The company was getting some small relief in the matter of coal, but the average cost per ton was still nearly 38 per cent. higher than it was a couple of years ago. If the Eight Hours Bill were passed, there would be small probability of a return to the reasonable prices of that period. At present the company was suffering from the general wave of bad trade and short time, and although, of course, not directly affected by the deplorable strike in the cotton mills, it must necessarily suffer when so large a number of the consumers of textiles were out of work. They would readily see how serious this was when they considered that the group of the various textile industries, for which the company supplied power, was more important than any other single group of customers, such as the colliery or engineering groups, and provided some 40 per cent. of the total receipts of the company. A time of slack trade might not in the long run be entirely a disadvantage. It was at such times that manufacturers were most disposed to consider economies, and the increasing number of the company's satisfied customers was rapidly proving the benefits to be derived from the adoption of electric driving. A comparison of the thin film of light smoke emitted from the chimneys of the power station with the dense cloud from many of the neighbouring chimneys would strike the most casual observer. It was the business of the Power Co. to study the most economical methods of raising steam. The manufacturer had other and more pressing matters to attend to, whilst it was really impossible for him with his small units of power and varying load to attempt to compete in this. Some day the inhabitants of the districts which still excluded the company's mains would realise what it would mean to them if the smoke pall which was so great a curse to the country were cleared away. The company's plant was all British made, and wherever its mains were laid they represented large sums paid in wages and employment found for labour. During the next few months several thousands of pounds would be spent in the district in extra labour alone on mains and works. This was not without importance at the present time, especially when it was remembered that wherever the mains were constructed new trades were stimulated, and extra rateable value created.

The report was adopted.

Mexican Light and Power Co.—The directors announce a dividend of 1 per cent. on the ordinary shares.

Cleveland and Durham Electric Power Co.—The directors report that during the year ended June 30th last, depression in trade on the North-East coast, with labour disputes, affected the demand for electric power, and, at the same time, demands for the extension of the company's system necessitated large capital expenditure. Agreements have been made with the Waste Heat and Gas Electrical Generating Stations Co. for the operation by the Cleveland and Durham Co. of power stations erected by that company at the works of the Weardale Steel, Coal, and Coke Co., at Tudhoe, Spennymoor, and Sir Bernard Samuelson and Co., (of Newport, Middlesbrough). As quoted in the *Times*, the report states that arrangements for a bulk supply and the extension of the mains system to Hartlepool have been completed, and it has lately been decided to link up this company's cable system with those of the companies further north. An important extension of mains is now proceeding from the north bank of the River Tees to the North-East Durham coalfield. A bulk supply to the Corporation of Middlesbrough was commenced in March last, and important contracts have been closed for supplying four new rolling mills, under construction in the Cleveland district. The connections to the company's system aggregate 20,105 H.P., as compared with 9,172 H.P. connected at June 30th last year. Arrangements have also been made for the connecting up of a further 8,850 H.P. The net revenue for the year, after writing down preliminary expenses by £10,000, amounts to £5,142, to which is added the sum brought forward from previous account. In April last an interim dividend of 5 per cent. on the preference shares was paid, which absorbed £7,120, and it is now proposed to carry forward to next account a balance of £1,252.

Eastern Extension, Australasia and China Telegraph Co.—Interim dividend for the quarter ended June 30th last of 2s. 6d. per share, free of income-tax.

Eastern Telegraph Co.—Second quarterly interim dividend of 1¼ per cent. on the ordinary stock, free of income-tax, in respect of profits for the year ending December 31st, 1908.

Stock Exchange Notices.—Applications have been made to the Committee to appoint a special settling day in and to grant a quotation to:—

Toronto Power Co., Ltd.—Scrip (fully and partly paid) for £500,000 4½ per cent. debenture stock.

And to allow the following to be quoted in the Official List:—

Underground Electric Railways Co. of London, Ltd.—£1,000,000 5 per cent. prior lien bonds, £2,800,000 4½ per cent. bonds of 1933 and £4,900,000 6 per cent. income bonds.

The Committee have ordered the undermentioned securities to be quoted in the Official List:—

Lanarkshire Tramways Co.—Further issue of 1,804 shares of £10 each fully paid.

Mexican Light and Power Co., Ltd.—Further issue of $900,000 7 per cent. cumulative preference stock in shares of $100 each.

West Kootenay Power and Light Co., Ltd.—£240,000 first mortgage 6 per cent. 35-year sinking fund gold coupon bonds of £100 each, Nos. 1 to 2,400.

Prospectuses.—*Metropolitan District Railway Co.*—This company has been offering the public an issue of £550,000 4 per cent. prior lien debenture stock at £97 10s. per £100. All existing mortgages on the company's surplus lands are to be paid off out of the proceeds of the issue.

Dumbarton Burgh and County Tramways Co., Ltd.—An issue of £80,000 5 per cent. debenture stock has been offered to the public this week, the list closing on Tuesday last.

Anglo-American Telegraph Co., Ltd.—The directors have resolved, after placing £5,000 to the credit of the renewal fund, to declare an interim dividend for the quarter ending September 30th, 1908, of 15s. per cent. on the ordinary stock, and £1 10s. per cent. on the preferred stock, less income-tax, payable on November 2nd.

Ernest Scott & Mountain, Ltd.—According to the *Financial Times*, the accounts for the year to June 30th, 1908, after deducting all manufacturing and agency charges, and including the amount brought forward, £27, show a profit of £10,191, which has been applied as follows:—Interest on debentures, bank charges, &c., £3,520; directors' fees and other charges, £795; depreciation of plant, machinery, and bad and doubtful debts, £5,876.

Shawinigan Water and Power Co.—A dividend of 1 per cent. for the quarter ended September 30th has been declared.

Okonite Co., Ltd.—Interim dividend of 8 per cent. per annum (1s. per share), less income-tax, on the ordinary shares for the quarter.

Brisbane Electric Tramways Investment Co.—Interim dividend of 2s. 6d. per share, tax free, on the ordinary shares for the half-year ended June 30th.

Calcutta Tramways Co., Ltd.—Interim dividend of 2s. per share on the ordinary shares (being at the rate of 4 per cent. per annum, free of income-tax), on account of the profits for the half-year to June 30th.

Germany.—The Rheydt Kabelwerke Gesellschaft, of Rheydt, reports a net profit of only £13,895 for the last financial year as against £39,999 in the preceding 12 months. No dividend is being declared.

Willans & Robinson, Ltd.

Mr. Mark Robinson, chairman, presided at the Cannon Street Hotel on Tuesday over the twenty-ninth half-yearly meeting of the above company.

The Chairman, in moving the adoption of the report (see Electrical Review, October 2nd, page 560), said that the prosperity of the business at Rugby, notwithstanding very adverse conditions of trade, had been well maintained and the profit made for the half-year was almost exactly the same as for the corresponding half of 1907. Nevertheless, the warning given in one of the paragraphs of the report must not be ignored. The times were very difficult, and the future was hard to foresee. Demand was small and competition great, and profits were cut to the lowest. Their best customers, the municipalities, were restricting their enterprises, partly in deference to a public feeling which was widely spread, but partly also, as regarded electric lighting, owing to the introduction of the metallic-filament lamp, which used so much less current than the old carbon lamps. Reduced cost to the consumer would doubtless be followed by a great extension of electric lighting, when more plant than ever would be wanted. But, for the present, there was an undoubted check, which acted unfavourably upon the most important section of their business—the manufacture of steam turbines. Nevertheless, they had a large number of important orders for turbines on hand, while the efforts to extend the scope of their business by cautiously taking up new classes of work, were beginning to bear fruit. The Diesel engine work was now considerable enough to be a welcome element in meeting their general charges, and if it could not yet be said that it did much more than this, the margin between cost and price was increasing, and they were justified in looking forward to a valuable business. Orders for condensing plants (independent of engines or turbines) were also beginning to form an important section of the business—a section entirely created within the last two or three years. The details of the accounts would doubtless have their consideration, but there did not appear to be very much to note in them. The sums owing to them and owing by them, were much the same as last time, though a little less. Rather less was locked up in miscellaneous materials and stocks. Amongst expenses there was an increase in legal and professional charges, but the whole amount was small. Advertising was lower—much lower than formerly—but, on the other hand, printing was increased. Travelling expenses were higher, mainly because, in the keener struggle for business, they found it increasingly necessary to be represented in the principal business centres. The organisation of this important work had been much improved, with results which were entirely promising, but it involved outlay. But while they saw the outlay, or much of it, in this item, they did not see the result, which was merged in the general profit. It was a trite explanation, which he had often given before—but always worth remembering—that the fewer orders they got, on account of badness of trade, the more they had to spend in getting them, simply because they were harder to get. As regarded Queen's Ferry, it was decided, after careful consideration, that the works should not be kept open beyond the present autumn. It was true that the losses shown in recent years were only nominally due to the works being open, for after allowing for their contributions towards directors' salaries, debenture interest, and for rent and other outgoings which must be paid in any case, the loss was no more than must be faced, whether the works were closed or open. There had been, however, a large sum locked up in working capital, which could otherwise have been profitably employed at Rugby. This fact, coupled with the continued failure of the attempt to get Queen's Ferry disposed of as a going concern—the only object for which the works were kept open at all—convinced them that the time had come for more drastic measures. The works were offered for sale by auction on September 16th. The reserve was not reached, but they did not expect that at the auction itself; they hoped better things from the negotiations which, as usual, the auction had brought about. He was sure that some of the shareholders, in view of the difficult times, would have preferred to see a smaller dividend on the ordinary shares, or even none at all. There was much to be said for that view, and if they had not given effect to it, it was only because other considerations had out-weighed it. With new profits, more than sufficient for the purpose, with a fair amount of profit already carried forward, and with expectations, no doubt raised by the steady progress of the last half-years, it seemed to them that it was unfair to suddenly cut down the dividend upon which many, no doubt, had reckoned. So this time they thought it right, on the whole, to advise the usual dividend. The board held the opinion, doubtless shared by others present, that the number of the directors should be larger, but after very full consideration they unanimously recommended that the question be deferred to the spring meeting, when they would be prepared with proposals upon the subject.

Mr. Wragg seconded the motion.

Sir Gilbert Clayton East proceeded to criticise the accounts in detail and at considerable length. He complained that practically nothing had been written off the leasehold premises, plant, and machinery account of Queen's Ferry. The patents and experiments account were also practically the same. In regard to the item of work in progress, he desired to know whether any probable losses had been allowed for, and in regard to materials and stores, whether as much had been written off for depreciation as formerly. The item of bills receivable, £7,751, he considered very unsatisfactory, and he also noticed that cash at bankers was greatly reduced. As to Queen's Ferry, was there sufficient standing in the debtor balances to meet their losses? When he left the board there was not. Further, he would like to know what provision had been made for a certain lawsuit. With regard to the reserve fund, which stood at £36,000, this was merely nominal, because the bulk of it was invested in the business, and to meet any emergency only £4,300 would be available. The company had no hidden reserves as it used to have, and he considered that they stood on the brink of a precipice. As to the profit and loss account, the profit was £4,473 lower than last year, and this appeared to have been arrived at after squeezing everything down. He contended that if proper depreciation had been allowed for Queen's Ferry, and for the Diesel engine account, there was no real profit at all. Sir Gilbert East proceeded to deal with personal matters, and said that Mr. Peache had evidently secured full control. At the last meeting of the company it was Mr. Robinson's turn for re-election, and Mr. Peache was going to oppose his election, but ten minutes before the meeting commenced Mr. Robinson gave way and signed an agreement with Mr. Peache to give up his work. Mr. Robinson had since told him that that agreement had been superseded by another one approved by the present board, but he contended that it never could be superseded. Now that Mr. Robinson had abdicated there was no reason for his large salary. Mr. Peache, in order to give him something to do, had put him on the accounts, but Mr. Peache knew that able man as Mr. Robinson was, yet his one great weakness was accounts. Then Mr. Anderson was paid a large salary for looking after Queen's Ferry, but as that was closed he supposed he would come down to £250. Mr. Peache was a good, common-sense practical engineer, and he was grateful to him for the improvements he had effected in the management of the shops, but he could not do all the work, which had consequently to be left to subordinates, who were wanting larger salaries. He was dissatisfied with the present state of affairs, and looked upon the future with alarm. He moved as an amendment, "That no dividend be paid upon the ordinary shares, and that £3,500 be transferred to the reserve account, to be invested in securities outside the business."

Mr. Adams seconded the amendment.

The Chairman said a great many statements had been made which were astonishing to him. With regard to writing down depreciation and all things affecting the prudent management of the company, everything had been done exactly as had been the case for many years past, and there was absolutely no reason for saying that anything had been shirked. Not a penny of anticipated profit for works in progress had been included in the accounts, and therefore the provision against any possible loss was far greater than used to be the case. The bills receivable were good, and a reserve had been made against them. He agreed that so long as the reserve was invested in the business it was a shadow, but of the sum invested outside they had made a profit on the H. S. Persse debentures. That morning their cash in the bank was £38,000. They had exactly the same hidden reserves as ever they had, and there had been no change whatever in their system of dealing with things. He did not quite accept the description of the personal events which had been given, although it was not widely wrong, but whatever took place before the last meeting, the fact was that the board had worked together with perfect harmony since that time. He was sorry that Sir Gilbert had not deferred his attack till their next meeting when they could compare the whole year's results. They had to recollect that when the accounts were made up Queen's Ferry was not closed.

Mr. Anderson said he had nothing to do with the agreement between Mr. Peache and the Chairman, but at the first meeting of the board they agreed to divide the work in a certain way, and the Chairman was appointed to look after the commercial work as before. They had worked harmoniously, although he agreed that the work was far too heavy for three directors. The depreciation had been carried out on the same lines as heretofore.

Mr. Peache said that the real practical thing which concerned the shareholders was that the board, as at present constituted, was working in thorough harmony.

The amendment was defeated by a large majority, and the report adopted.

Swansea Improvements and Tramways Co.—The report for the half-year ended June 30th, 1908, states that the gross receipts on the tramway undertaking, were £24,267, being an increase of £1,950 upon the corresponding period of last year, and the expenses to £19,690, an increase of £1,115. The expenses include debenture and other interest and the amount payable to the Swansea Corporation in respect of the tramways and light railways leased from the Corporation. The profit on the half-year's working is £4,576, plus £1,532 brought forward, making £6,108 at the credit of profit and loss account; £1,000 is to be placed to reserve and depreciation fund, a dividend on 984 preference shares at the rate of 6 per cent. per annum, and at the rate of 5 per cent. per annum is proposed on 4,016 preference shares, leaving to be carried forward £3,809. The net loss on the improvements undertaking for the half-year amounts to £255, after allowing £304 for accrued interest on mortgages.

Liberian Rubber Corporation, Ltd.—At the annual meeting last week Sir Raymond West, who presided, said that they had put into force a drastic scheme of retrenchment. The fall in the price of rubber had rendered some stations unprofitable, and 15 of them had had to be closed. They would soon turn round the corner and get on to a dividend-paying basis if they could secure a reasonable rise in the price of their product. The year's operations had resulted in a loss of £7,900.

South Metropolitan Electric Light and Power Co., Ltd.—Warrants for interest on the 4½ per cent. first mortgage debenture stock for the half-year ended September 30th, 1908 (payable October 1st) have been posted.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	Receipts for the fortnight. £*	No. of wks.	Total to date. £	Total to date. £*	Route miles open.	Inc.
Aberdeen	Sept. 30	2,816	— 174	18	27,557	— 448	14·4	..
Ayr	Oct. 3	578	— 58	20	8,179	— 291	8	..
Bath	Sept. 29	1,666	— 198	39	29,825	— 2,316	13	..
Belfast	Oct. 2	7,411	— 427	27	97,952	— 1,596	37	..
Birkenhead	,, 4	2,231	— 14	27	29,324	+ 512	13·52	..
Birmingham Corp.	Sept. 26	12,999	— 252	26	168,655	+ 5,482	56·46	..
†Blackburn	,, 2	1,117	— 100	23	27,098	+ 996	14·18	..
Blackpool Corp.	,, 17	3,906	— 859	..	97,578	— 983	11·87	..
,, —Fleetw'd.	Oct. 3	1,557	— 358	13	17,667	— 2,182	8·25	..
Bolton	,, 4	4,758	+ 149	27	64,2·3	+ 1,162	26	..
Bournemouth	Sept. 30	3,685	+ 2	26	47,849	— 2,985	21·72	..
Bradford	,, 26	9,099	— 728	25	128,825	— 130	54·9	1
Brighton	Oct. 4	1,988	+ 30	26	27,389	+ 465	9·5	..
Bristol	,, 2	10,254	— 166	..	..	..	30·5	..
Brit. Elec. Trac. Co.								
Airdrie	Sept. 25	454	— 10	38	8,504	+ 24	3·65	..
Barnsley	,, 25	354	+ 16	,,	6,805	+ 384	..	..
Barrow	,, 25	582	— 85	,,	9,616	— 447	5·37	..
Cavehill	,, 25	171	— 38	,,	3,546	+ 155	..	..
Devonport	,, 25	980	— 22	,,	17,771	— 3	8·85	..
Gateshead	,, 25	2,092	+ 47	,,	38,606	+ 168	11·25	..
Gravesend	,, 25	458	— 88	,,	8,285	— 1,307	6·5	..
Greenock	,, 25	1,050	— 309	,,	20,480	— 5,085	7·25	..
Hartlepool	,, 25	488	— 152	,,	9,334	— 1,973	6·72	..
Kidderminster	,, 25	214	— 63	,,	4,445	— 822	..	..
Leamington	,, 25	402	— 16	,,	6,599	+ 344	3	..
Merthyr	,, 26	434	— 14	,,	8,108	+ 52	2·9	..
Metropolitan	,, 25	12,746	+1,716	,,	220,011	+40,521	22	..
Middleton	,, 25	661	— 111	,,	14,008	+ 213	8·5	..
Mid. Joint Com'tee	,, 25	11,619	— 728	,,	220,886	— 3,541	..	..
Oldham—Ashton	,, 25	1,130	— 161	,,	22,851	— 440	9·18	..
Peterborough	,, 25	278	— 11	,,	4,936	+ 5	5·31	..
Potteries	,, 25	3,704	— 233	,,	69,226	— 1,424	29	..
Rothesay	,, 25	368	— 187	,,	9,097	— 405	2·75	..
Southport	,, 25	595	— 98	,,	11,190	— 860	8·17	..
S. Metropolitan	,, 25	1,762	— 170	,,	31,299	+ 60	..	..
Swansea	,, 25	1,939	— 122	,,	36,242	+ 959	12·5	..
Tynemouth	,, 25	465	— 115	,,	9,206	— 767	3·75	..
Weston-s-Mare	,, 23	378	— 185	,,	6,172	— 288	3	..
‡Worcester	,, 25	639	— 44	,,	10,994	— 92	5·75	..
Wrexham	,, 55	241	+ 7	,,	3,960	— 17	..	..
Yorks. Wool. Dist.	,, 21	1,898	+ 62	,,	35,169	— 1,052	17	..
Miscellaneous	,, 25	425	— 43	,,	7,990	— 744	..	..
†Burnley	Oct. 3	1,359	— 19	..	..	..	7·5	..
Burton-on-Trent	,, 4	560	— 38	27	7,509	— 592	10	..
Bury	,, 4	2,512	+ 178	26⅔	32,785	+ 1,874	22·5	..
Cardiff	Sept. 12	4,424	— 36	24	53,523	— 503	..	..
Carlisle	Oct. 3	412	+ 76	40	7,703	+ 55	..	..
Chatham and Dist.	,, 1	1,890	+ 300	39	30,677	+ 1,471	14·88	2·14
Cork	,, 1	988	— 91	39	18,174	— 735	9·89	..
Croydon	,, 2	2,969	— 59	27	39,204	— 682	11·25	..
Darlington	,, 3	405	— 15	27	5,422	— 392	..	..
Darwen	,, 2	481	— 52	43	6,880	— 160	4·36	..
Dover	Sept. 26	480	— 47	26	6,264	— 263	4·75	..
Dublin	Oct. 2	10,812	—3,163	..	77,835	—23,562	54·25	5·5
Dundee	Sept. 30	2,430	+ 97	19⅔	24,408	+ 1,404	14·5	..
East Ham	Oct. 3	1,876	— 34	27	23,741	— 1,336	8·43	·68
Exeter	,, 2	691	+ 28	27	8,998	— 190	5·5	..
Glasgow	,, 3	36,689	—1,409	..	309,449	— 5,181	89·5	·5
Hastings	,, 1	2,473	— 102	..	..	..	..	..
Huddersfield	,, 3	3,536	— 75	27	44,296	— 107	28·5	·5
Hull	,, 3	5,003	— 144	27	65,304	+ 313	13	..
Ilkeston	Sept. 30	292	+ 28	26	3,845	+ 10	3·5	..
Ipswich	Oct. 3	1,071	+ 7	27	11,532	— 304	10·5	..
Kilmarnock	Sept. 26	304	— 11	19	3,017	— 196	4·26	..
Lan'kshire Trm. Co.	Oct. 1	2 723	— 103	39	50,687	+ 3,199	17	1·18
Lancashire United	Sept. 30	2,765	— 13	39	52,810	+ 2,088	39	1
Leeds	,, 26	13,059	— 436	25	174,535	+ 3,645	96·75	·25
Leicester	Oct. 3	4,486	+ 38	..	..	..	..	..
Leith	,, 3	1,068	+ 6	20⅔	11,288	— 25	6	..
Liverpool	Sept. 26	21,480	—1,130	39	415,835	— 9,308	104	..
†L.C.C.	,, 19	73,411	+7,333	..	867,118	+93,452	121¾	..
London United	Oct. 3	14,931	— 786	..	268,902	+ 2,718	..	..
Lowestoft	Sept. 19	692	— 42	51	10,672	+ 100	3·5	..
Manchester	Oct. 3	31,408	— 295	27	411,826	+ 9,668	89·5	11
Newcastle	,, 3	7,966	— 139	27	105,146	— 6,216	..	..
Newport	,, 3	1,345	— 2	27	18,382	— 1,676	14·5	..
Northampton	,, 2	958	+ 53	26⅔	12,896	..	5·5	..
Oldham	,, 4	4,014	+ 20	27	55,678	+ 405	23·75	..
†Pontypridd	Sept. 26	411	+ 138	26	9,814	+ 2,888	5	1·75
Portsmouth	Oct. 3	4,160	— 22	27	58,916	— 82	14·5	..
Preston	Sept. 30	1,492	— 32	..	..	..	..	..
Reading	Oct. 1	1,277	— 12	26⅔	17,105	+ 186	13·25	..
Rotherham	,, 1	1,240	+ 8	26⅔	16,356	+ 52	10	·66
Salford	Sept. 28	9,470	— 495	36	123,794	— 494	38·9	..
Sheffield	,, 27	11,099	— 331	26⅔	149,514	— 1,335	37	1·25
Southampton	,, 30	2,217	— 22	26	29,712	+ 1,459	..	..
Southend-on-Sea	,, 30	1,019	+ 64	27	13,728	+ 941	..	..
†South Shields	,, 26	547	— 6	..	15,052	— 859	..	..
†Swindon	,, 30	145	— 39	..	..	..	4·4	..
Tyneside	,, 30	847	— 62	13	5,679	— 653	8·87	..
Wallasey	Oct. 3	1,827	+ 111	26⅓	25,150	+ 1,077	8·72	·22
Walthamstow	,, 3	1,942	— 94	27	18,455	+ 765	9	..
West Ham	Sept. 24	4,360	— 846	26	58,257	— 3,613	14·7	..
Wolverhampton	,, 30	1,677	— 74	26	23,645	— 555	12·5	..
Baker St.-Waterloo	Oct. 3	6,445	+1,630	14	41,065	+ 9,105	4·25	1
Cen. London Rly.	,, 3	16,896	+6,594	14	103,239	+35,358	5·77	..
Char. +, Eus. Hamp.	,, 3	6,910	+1,620	14	45,740	+10,545	7·75	..
City & S. Lon. Rly.	,, 4	6,189	+ 109	14	41,596	— 835	7·8	1·05
Dublin-Lucan Rly.	,, 3	291	+ 11	13	2,105	— 79	7	..
G.N. and City Rly.	,, 3	2,693	— 609	14	18,117	— 4,116	3·5	..
G.N., P'dy. & Brmtn.	,, 3	10,775	+2,355	14	69,260	+14,515	9·25	·25
L'pool Overh'd Rly.	,, 4	2,769	+ 251	14	20,177	— 2,756	6·8	4·3
Mersey Railway	,, 3	3,885	+ 32	14	25,988	+ 519	4½	..
Metropolitan Rly.	,, 4	36,392	+5,429	14	225,416	+15,975	24·5	..
Met. District Rly.	,, 3	19,404	+3,557	14	125,380	+21,664	24	..
Anglo-Argentine	Sept. 30	49,938	+16,805	39	791,375	+148,607	48	..
§Auckland	,, 11	12,893	+2,993	52	111,049	+17,575	22·3	3·1
Bombay (B.E.T.)	,, 10	4,909	+ 530	36	85,222	+15,884	..	..
§Brisbane	,, 30	14,490	+1,830	..	..	..	..	..
Calcutta	Oct. 3	6,900	+ 186	..	..	..	..	..
§Kalgoorlie, W.A.	,,	422	..	..	30,951	..	20·5	..
Madras	Sept. 30	1,144	+ 88	39	22,308	+ 1,681	12·75	..
†Perth (W.A.)	Oct. 2	2,618	+ 31	40	54,517	+ 1,101	25·6	..

* Compared with the corresponding period of 1907. † One week only.
‡ Includes horse, steam and other receipts. § One month.

STOCKS AND SHARES.

Tuesday Afternoon.

Some time has elapsed since the Near Eastern question troubled the Stock Exchange, but this lapse of opportunity is being amply compensated now. Bulgaria tossed a bolt from the blue into the markets on Monday in announcing her independence. Hardly a market escaped from the effect of the political bombshell, and although prices rallied after their first slump, confidence has been shaken, and business is likely to be thereby retarded just as it was beginning to gain a small measure of activity.

Home Railway stocks felt the full force of the shock, and suffered more than any other department, except the foreign government bond market. There had been a little speculation at work, buyers predominating, and upon the Bulgarian scare, prices were dropped smartly. Undergrounds fell with the rest. Metropolitan Consolidated advanced to 42, but returned to 40. Districts went over 15 before easing off to 14. The remarkable accident of Saturday last, when three tube railways found the current suddenly cut off, may have had something to do with the selling of Districts. The Central London issues are decidedly better, while City and South London, after rising 1½, fell away again.

Metropolitan District Debenture stocks improved very considerably, in preparation, some people said, for the new 4 per cent. prior lien Debenture issued early this week at 97½. The existing 4 per cent. Debenture came up from 78 to 84, and the 4 per cent. Debenture stock of 1903-5 put on several points to 81. Moreover, the stocks are difficult to get hold of; in fact, there is only the 1903-5 to be obtained. The company is, of course, doing much better, and the prior lien appears to have a good margin of security behind it. A few months ago, however, a new issue at 97½ of 4 per cent. stock would probably have been hailed with derision and followed by failure.

The impression that the Anglo-American Telegraph Co. might cut its dividend has not materialised, and upon announcement of the usual 15s. per cent. on the Ordinary stock, a decline in the prices was checked, although the Deferred still shows a small fall on balance. It was but last week, of course, that the price of this volatile stock enjoyed a substantial rise. Eastern Ordinary and Preference stocks have improved ½ each, but China shares did not move. Both the Globe Telegraph and Trust shares are *ex* dividend, the nominal quotations remaining unchanged. Submarine Cables Trust certificates rose a point.

Marconi shares lost 1/16, falling to 7s. 6d., upon re-circulation of fears that the company may want more money.

American Telephone and Telegraph capital stock is 1 lower, *ex* 2 per cent. dividend. United River Plate Preference gained ¼ and the National Telephone group shows no alteration.

The "Canadian" group of light, power and traction securities is very irregular. Mexico Tramways Common stock rose eight points to 134½ and then came back to 132; a dividend of 1 per cent. has been declared. The bonds keep about 92½, and look a reasonable 5¼ per cent. risk. Rio shares have slipped back a little, at 66¾ being ¾ down. Sao Paulo shares at 154 are 3 down, but the dividend of 2½ came off the price last week. Havana Electric Railway Consolidated Mortgage 5 per cent. bonds have been picked up at about 89. As regards other traction varieties, Metropolitan Electric Tramways Preference are firmer at 15s. Potteries Preference eased off to 12s. 6d. London United Tramways Preference shares and Debenture stock are both lower, with losses of 10s. and 40s. respectively. British Electric Tractions remain flat. Deduction of the dividend explains most of the fall in Anglo-Argentine Tramways Second Preference shares. United Electric Tramways of Monte Video Ordinary strengthened to 6½, and the Preference were firm at 5⅞.

What few fluctuations have taken place in the list of electricity supply shares are mostly due to *ex* dividend markings. There is, however, a slight disposition to buy shares of the best class London companies, as is usual at the beginning of the autumn. The inclination is evident in rises secured by Westminster Ordinary, and St. James' and Pall Mall Ordinary, both shares gaining 5s. River Plate Ordinary are ⅛ better at 1 1/16. Mexican Light and Power Common stock has been subjected to profit-taking, and fell 3½, which caused the bonds to weaken a little. Mexican Electric Light bonds are also duller, as may be observed by references to our price lists overleaf, to which many additions have been made. Victoria Falls Power Preference drooped to 12s. 6d. in the general reaction which overtook the Kaffir Circus upon the Bulgarian *coup de main*.

Manufacturing issues are quiet and steady, and prices show no changes of importance.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. *	Dividends for the last four years. 1904.	1905.	1906.	1907.	Closing Quotations Sept. 29th.	Closing Quotations Oct. 6th.	Business done week ended Oct. 6th, 1908. Highest.	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	Nil	2 — 3	2 — 3	..	..	..	Nil.
143,800	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	5 %	5 %	5 %	90 — 93	90 — 93	..	..	..	5 7 6
$131,551,400	American Telephone & Telegraph, Cap. Stock ..	$100	7½%	7½%	8 %	8 %	131 —135	130 —134 xd	130½	..	..	5 19 5
53,000,000	Do. Collat. Trust, 4% Bonds, 1 to 28,000 and 53,001 to 78,000	$1000	4 %	4 %	4 %	4 %	93 — 95	93 — 95	95½	..	..	4 4 3
598,180	Anglo-American Telegraph	Stock	2¾%	3½%	3¾%	3½%	58 — 61	58 — 61	..	..	..	5 14 9
8,200,910	Do. do. do. 6 % Pref.	Stock	5½%	6 %	6 %	6 %	103½—104½	103½—104½	104¾	103½	..	5 14 10
8,200,910	Do. do. do. Deferred	Stock	Nil	½%	1¾%	1 %	17½ — 18	17 — 17½	17⅞	17½	— ⅛	5 14 3
50,000	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	..	5 %	5 %	5 %	99 —102	99 —102	..	..	..	4 16 2
44,000	Chili Telephone, Nos. 1 to 44,000	5	8 %	8 %	8 %	8 %	8 — 8½	8 — 8½	..	..	..	4 14 1
2,383,376	Commercial Cable Stlng. 500 year 4 % Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	89 — 91	88 — 90 xd	90½	89½	..	4 8 11
16,000	Cuba Telegraph	10	5 %	5 %	5 %	6 %	7½ — 8½	7½ — 8½	..	..	..	7 1 2
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	10 %	16 — 17	16 — 17	..	..	..	6 17 8
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	8 — 8½	8 — 8½ xd	..	..	..	6 8 1
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	8½ — 9½	8 — 9 xd	..	..	..	6 8 1
80,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	8 14 10
60,710‡	Direct United States Cable	20	3½%	4½%	4¾%	4½%	13½—13⅝	13½—13⅝	13⅝	..	..	6 3 8
50,900‡	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,900, R.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 3
4,000,000	Eastern Telegraph, Ord. Stock..	Stock	7 %	7 %	7 %	7 %	135½—138½	136 —139	138	136½	+ ½	5 0 9
2,000,000	Do. 3½ % Pref. Stock..	100	3½%	3½%	3½%	3½%	84½— 86½	86 — 87	86½	85½	+ ½	4 0 6
1,896,706	Do. 4 % Mort. Deb. Stock. Red. ..	Stock	4 %	4 %	4 %	4 %	103 —105	103 —105	104½	103½	..	3 16 2
800,000	Eastern Extension, Australasia, and China Tels.	10	7 %	7 %	7 %	7 %	12½— 13½	12½— 13½	13	12½	..	5 5 8
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	101 —103	101 —103	102½	101½	..	3 17 8
269,700	East & S. Afric. Tel., 4 % Mt. Db., 1 to 8,000, red. 1909	100	4 %	4 %	4 %	4 %	99½—101½	99½—101½	..	..	..	3 18 10
200,000‡	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	101½—103½	101½—103½	..	..	..	3 17 4
181,127	Globe Telegraph and Trust	10	5⅞%	5½%	5½%	5½%	10⅝— 11⅛	10⅝— 11⅛	10⅝	10⅜	..	5 5 8
181,127	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	13⅝— 14⅛	13⅝— 14⅛	14	13⅝	..	4 4 3
150,000	Great Northern Telegraph, of Copenhagen.. ..	10	24 %	24%	20 %	20 %	30 — 32	30 — 32	..	..	..	6 5 0
19,600‡	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,300, Red.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 3
17,000	Indo-European Telegraph	25	13 %	13 %	13 %	13 %	56 — 59	56 — 59	..	..	..	6 7 1
$41,380,400	Mackay Companies Common	$100	1 %	2 %	3½%	4 %	68 — 72	68 — 72	..	..	..	5 9 7
$50,000,000	Do. do. 4% Cum. Pref.	$100	4 %	4 %	4 %	4 %	68 — 72	68 — 72	..	..	..	5 9 7
884,190	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	Nil	⅜ — ½	⅝ — ¾	7/6	..	— 1/16	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	4 %	5 %	6 %	6 %	1 — 1⅛	1 — 1⅛	21/6	..	..	5 6 8
86,492	Do. do. do. 5 % Pref. ..	5	5 %	5 %	5 %	5 %	¾ — 1	⅞ — 1	..	..	..	5 0 0
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	109 —111	109 —111	110½	109	..	5 8 1
3,725,000	Do. do. Def. Stock	100	5 %	5 %	5 %	6 %	118 —120	118 —120	119	118	..	5 0 0
15,000	Do. do. 6 % Cum. 1st. Pref.	10	6 %	6 %	6 %	6 %	10½— 11½	10½— 11½	..	..	..	5 6 8
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10½— 11½	10½— 11½	..	..	..	4 8 11
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅛— 5⅝	5⅛— 5⅝	5⅛	..	+ 1/16	4 6 11
2,000,000	Do. do. 8½ % Deb. Stock Red. ..	Stock	8½%	8½%	8½%	8½%	98½—100½	98½—100½	..	..	..	8 7 8
1,716,598	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	102 —104	102 —104	103	102½	..	3 16 11
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid ..	1	6¾%	7 %	7 %	8 %	1½— 1⅝	1½— 1⅝	25/6	25/3	..	5 16 4
50,000	Do. do. do. 6 % Cum. Pref.... ..	1	6 %	6 %	6 %	6 %	1 1/16— 1 1/16	1 1/16— 1 1/16	24/-	..	..	4 11 5
99,100	Do. do. do. 4 % Red. Deb. Stock ..	100	..	4 %	4 %	4 %	89 — 92	89 — 92	..	..	..	4 7 0
99,400	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	10	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..	3 18 5
11,839‡	Reuter's	8	5 %	5 %	5 %	5 %	7¼— 8½	7¼— 8½	..	..	..	5 0 0
99,100	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	4½%	4½%	4½%	99 —102	99 —102	..	..	..	4 8 3
5,083	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	129 —133	130 —133	..	..	+1	4 10 3
100,000	United River Plate Telephone	5	8 %	8 %	8 %	8 %	6⅞— 7⅛	6⅞— 7⅛	7⅛	..	..	5 14 3
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	4⅜— 4⅝	5 — 5⅛	..	..	+ ⅛	4 10 11
80,008	W. Coast of America, 1 to 80,000 & 53,001 to 53,008	2½	Nil	Nil	2½%	2½%	1¼— 1½	1¼— 1½	..	..	..	4 3 4
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..	3 18 5
207,980	Western Telegraph, Ltd., Nos. 1 to 207,980.. ..	10	7 %	7 %	7 %	7 %	13⅝— 14⅛	13⅝— 14⅛	14	13⅝	..	4 18 3
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	101½—103½	101½—103½	102	..	..	3 17 4
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	Nil	⅜ — ½	⅜ — ½	12,6	..	..	Nil
34,563	Do. do. 6 % Cum. 1st Pref.	10	6 %	5 %	8 %	6 %	8 — 8½	8 — 8½	8½	8½	..	7 1 2
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	£2 6	8½— 9½	8½— 9½	..	..	..	2 9 0
80,000‡	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	101 —103	101 —105	..	..	..	4 17 1

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

530,000	Anglo-Argentine Trams, 10 % Nom. Cum. 2nd Pref., 260,008 to 530,097	5	8 %	8 %	8 %	9 %	8 11/16— 8 13/16	8⅝— 8⅝ xd	8 3/16	8 1/16	..	5 4 4
260,007	Do. 6 % Cum. Prefs., 1 to 260,007 ..	5	5½%	5½%	5½%	5⅝%	6¼ — 6¼	6½ — 6½	6⅝	..	..	4 11 2
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	6 %	6 %	6 %	6 %	148 —148	148 —148	..	..	..	4 6 11
285,100	Auckland E. Trams, 5 % 1st Mort. Deb. Stock ..	100	5 %	5 %	5 %	5 %	103 —106	103 —106	..	..	..	4 14 4
580,000	Babcock & Wilcox, 1 to 580,000	1	20 %	20 %	20 %	20 %	3 13/16— 4 1/16	3⅞— 4 xd	77/6	76/3	..	5 0 0
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	6 %	1⅛— 1⅜	1⅛— 1⅜	..	..	..	8 13 10
40,000	British Aluminium, Ord., 1 to 40,000	5	7 %	7 %	7 %	7 %	2⅜— 2⅝	2⅜— 2⅝	51/3	..	..	12 3 6
40,000	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	3⅝— 4⅛	3⅝— 4	..	..	— ⅛	8 15 0
20,000	Do. do. "A" 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	4⅛— 4⅜	4⅛— 4⅜	..	..	..	6 6 4
20,000	Do. do. 4 % Funding Certs.	5	4 %	4 %	4 %	4 %	3¾— 4⅛	3¾— 4⅛	..	..	..	4 14 1
238,200	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	109 —110	109 —110	..	..	..	4 10 11
300,000	Do. do. 5½ % Loch Leven Debs. ..	100	..	..	5½%	5½%	97 —100	97 —100	..	..	..	5 10 0
400,000	British Columbia E. Rail Def. Ord. Stock ..	100	6 %	6 %	6 %	8 %	136 —140	136 —140	136½	..	..	5 14 4
300,000	Do. 5 % Pref. Ord. Stock	100	5 %	5 %	5 %	5 %	117 —121	117 —121	..	..	..	4 2 8
300,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	6 %	105 —109	105 —109	..	..	..	4 11 9
238,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	4½%	4½%	4½%	4½%	102 —104	101 —104	..	..	..	4 6 7
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	100½—103½	101 —104	..	..	+ ½	4 7 0
138,301	British Electric Traction	10	6 %	3 %	Nil	Nil	⅜ — ½	⅜ — ½	..	..	..	Nil
161,437	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	8 %	3¾— 4⅛	3¾— 4⅛	..	..	..	7 1 2
1,473,653	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	96 — 99	96 — 96	94½	93⅝	—3	5 4 2
528,986	Do. do. 4½ % 2nd Deb. Stock Red.	100	4½%	4½%	4½%	4½%	76 — 78	76 — 78	..	..	..	5 15 5
100,000	British Insulated and Helsby Cables	5	8 %	8 %	10 %	10 %	6¼— 6⅝	6¼— 6⅝	6 1/16	..	..	7 8 2
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	6 — 6⅛	6 — 6⅛	..	..	..	4 12 4
500,000	Do. do. 4½ % 1st Mort. Deb. Red...	100	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..	4 4 11
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	4½%	91 — 96	91 — 96	..	..	..	4 13 9
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	Nil	Nil	Nil	Nil	1/16— 1/16	1/16— 1/16	..	..	..	Nil
1,016,353	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	40 — 45	40 — 45	41	..	..	8 17 10
50,000	Browett, Lindley & Co., Ord.	1	Nil	Nil	Nil	Nil	3/16— 1/4	3/16— 1/4	..	..	..	Nil
50,000	Do. do. 6 % Cum. Pref.	1	Nil	Nil	Nil	Nil	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	2½%	Nil	Nil	0 — ⅛	0 — ⅛	..	..	..	Nil
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	Nil	Nil	⅛ — ¼	⅛ — ¼	..	..	..	Nil
125,000‡	Do. do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	68 — 73	68 — 73	..	..	..	6 3 3
125,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock..	Stock	4½%	4½%	4½%	4½%	50 — 54	50 — 54	..	..	..	8 6
137,610	Calcutta Trams, 1 to 137,610	5	8 %	8 %	8 %	6 %	5½ — 6	5½ — 6	5⅝	..	..	5 0 0
30,000	Do. 5 % Cum. Pref., Nos. 1 to 29,230..	5	..	5 %	5 %	5 %	4½ — 5½	4½ — 5½	..	..	..	4 15 3
850,000	Do. 4½ % 1st Deb. Stock..	100	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..	4 4 11
85,000	Callender's Cable Construction shares	5	12½%	15 %	15 %	15 %	9½— 10⅜	9½— 10⅜	..	..	..	6 19 6
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5½— 6⅜	5½— 6⅜	..	..	..	6 6 11
800,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	107½—109½	107½—109½	..	..	..	4 2 2
491,222	Cape E. Trams., 1 to 491,222	1	5 %	Nil	Nil	Nil	⅛ — ¼	⅛ — ¼	..	..	..	Nil
450,000	Casimer-Kellner Alkali, 1 to 450,000	1	4 %	6 %	8 %	12 %	1 1/16— 1 1/8	1 1/16— 1 1/8	33/-	31/10½	..	7 14 10
215,045	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4½%	4½%	108 —107	105 —107	..	..	..	4 4 1
1,898,610	Central London Railway, Ord. Stock..	Stock	4 %	4 %	4 %	3 %	68 — 70	71 — 73	73½	71	+ 3	4 2 2
558,195	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	85 — 87	86 — 88	87½	..	+ 1	4 6 11
558,195	Do. do. Def. do.	Stock	4 %	4 %	4 %	2 %	50 — 53	51 — 54	53½	52	+ 1	3 14 1
1,480,000	City and South London Railway	Stock	3½%	1¾%	3½%	3½%	32½—33½	32½— 33½	34	..	..	6 6 10

* Unless otherwise stated, all shares are fully paid. † A period of nine months. ‡ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations Sept. 29th.	Closing Quotations Oct. 6th.	Business done week ended Oct. 6th, 1908.		Rise + or Fall —	Present Yield per cent.
		*	1904.	1905.	1906.	1907.			Highest.	Lowest.		£ s. d.
85,000	Crompton & Co., Nos. 1 to 85,000	£	2½%	2½%	5 %	5 %	1⅝ — 1⅞	1⅝ — 1⅞	..	..	..	9 10 6
100,000‡	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	98 —101	98 —101	100	..	..	4 19 0
260,000	Dick, Kerr & Co., 1 to 260,000	1	10 %	10 %	10 %	10 %	1⅜ — 1⅝	1⅜ — 1⅝ xd	26/3	..	..	7 12 5
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	6 %	1 — 1⅛	1 — 1⅛ xd	..	..	..	4 16 0
282,580	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
60,000	Dublin United Trams. (1896), 1 to 60,000	10	6 %	6%	6 %	6%	11½ — 12½	11½ — 12½	..	..	..	5 4 0
59,987	Do. 6 % Pref. between 1 and 60,000	10	6 %	6 %	6 %	6 %	12½ — 13½	12½ — 13½	..	..	..	4 8 11
99,261	Edison & Swan Utd., "A" shs., £3 pd., 1 to 99,261	£ 5	2½%	4½%	4½%	4½%	⅞ — 1	⅞ — 1	..	..	..	16 12 6
17,199	Do. "A" shares, 01—017,199	£ 5	2½%	4½%	4½%	4½%	1½ — 2½	1½ — 2½	..	..	..	8 6 9
319,475	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	76 — 79	76 — 79	..	..	..	5 1 3
72,220	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	85 — 87	84 — 87 xd	..	..	..	5 14 11
112,100	Electric Construction, 1 to 112,100	£	4 %	Nil	Nil	Nil	⅜ — ⅝	⅜ — ⅝	..	..	..	Nil
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890	£	7 %	7 %	7 %	7 %	1⅛ — 1¼	1⅛ — 1¼	..	..	— ⅛	8 0 0
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	5 %	7½ — 8	7½ — 8	..	..	..	6 5 0
200,000	Do. do 4 % Mort Deb.	Stock	4 %	4 %	4 %	4 %	86 — 90	84 — 88 xd	..	..	..	4 10 11
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	4 %	4 %	4 %	4 %	¾ — 1	¾ — 1	..	..	..	5 0 0
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	7 %	10½ — 10⅞	10½ — 10	..	..	..	6 10 8
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	103 —103	102 —103½	..	..	..	4 17 1
40,000	Henley's (W. T.), Telegraph Works, Ord.	£ 5	15 %	15%	15 %	15%	10½ — 11½	10½ — 11½	..	..	..	7 8 2
40,000	Do. do. 4½ % Pref.	£ 5	4½%	4½%	4½%	4½%	5 — 5⅝	5 — 5⅝	5⅝	..	..	4 1 10
150,000	Do. do. 4½ % Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	107 — 109	107 —109	..	..	..	4 2 7
60,000	India-Rubber, Gutta-percha & Telegraph Works	10	5 %	10%	10 %	10 %	16 — 17	16½ — 17½	..	..	+ ½	5 14 3
87,500	†Liverpool Overhead Railway, Ord.	10	1½%	Nil	Nil	Nil	1⅛ — 1½	1⅛ — 1½	..	..	..	4 0 0
10,000	† Do. do. Pref., fully paid	10	5 %	5 %	5 %	5 %	5 — 5½	5 — 5½	..	..	..	9 1 10
600,070	London United Trams. (1901), 1 to 50,007	10	6 %	8 %	8 %	8 %	6⅜ — 6⅝	6⅜ — 6⅝	..	..	..	4 8 11
899,930	Do. do. 60,008 to 100,000	10	6 %	8 %	8 %	8 %	6⅜ — 6⅝	6⅜ — 6⅝	..	..	..	4 8 11
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	5 %	5 %	5⅜ — 6⅛	4⅜ — 5⅜	5⅛	..	— ⅛	6 13 4
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	75 — 80	73 — 74	..	..	— 2	5 2 7
5,782,062	Metropolitan Consolidated	100	3 %	2½%	1 %	¾%	39½ — 40½	40½	41⅛	39½	..	1 4 6
2,640,914	Do. Surplus Lands	100	2½%	2½%	2½%	2½%	66 — 68	68 — 70	69	67⅞	+2	3 18 7
3,235,000	Do. District	100	Nil	Nil	Nil	Nil	14 — 15	13½ — 14⅜	15 1/16	13½	— ⅛	Nil
314,016	Metropolitan Electric Trams., Defd.	1	Nil	Nil	Nil	Nil	3/16 — 5/16	3/16 — 5/16	..	..	..	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	3/16 — 5/16	3/16 — 7/16	..	..	— 1/16	6 8 1
350,000	Do. do. 4½ % Deb. Stock Red.	100	4½%	4½%	4½%	4½%	92 — 95	92 — 95	93½	..	..	4 14 9
245,500	Potteries E. Trc.	1	5 %	4 %	4 %	4 %	⅛ — ¼	⅛ — ¼	..	..	..	8 0 0
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	3/16 — 5/16	3/16 — 5/16	..	..	..	6 17 11
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	92 — 95	92 — 95	..	..	..	4 14 9
87,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	17½%	32 — 34	32 — 34	33½	32	..	6 18 8
150,000‡	Do. 4 % Deb. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	4 %	101 —103	101 —103	..	..	..	3 17 8
3,599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	5 %	5 %	5 %	5 %	43 — 47	43 — 47	..	..	+1	10 12 0
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	1	Nil	Nil	Nil	10 %	⅜ — 1½	⅜ — 1½	17/6	..	..	8 0 0
66,666	Do. 6 % C.P., 30,001 to 80,000 & 125,001 to 141,666	5	Nil	Nil	..	6 %	2⅜ — 3⅜	2⅜ — 3⅜	61/3	55/-	+ ⅜	9 4 7
46,404	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	72 — 76	72 — 76	..	..	..	5 5 3

ELECTRICITY SUPPLY COMPANIES.

15,000	Bromley (Kent) E.L. & P., 1 to 15,000	£	6¾%	6¾%	6¾%	6¾%	4⅜ — 5	4⅜ — 4⅝ xd	..	..	..	5 11 5
70,000	Do. do. 4½ % 1st. deb. stock	100	4½%	4½%	4½%	4½%	96 —100	96 —100	..	..	..	4 10 0
80,181	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	£ 5	10 %	10 %	10%	10 %	7 — 8	7 — 8	..	..	..	6 5 0
9,869	Do do. 7 % Cum. Pref.	£ 5	7 %	7 %	7 %	7 %	7 — 8	7 — 8	..	..	..	4 7 6
836,876	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	99 — 102	99 —102	109	..	..	3 18 5
80,000	Charing Cross and Strand Electricity Supply	£ 5	8 %	5 %	5 %	5 %	3⅝ — 4	3⅝ — 4	75/-	..	..	6 5 0
80,000	Do. do. do. 4½ % Cum. Pref.	£ 5	4½%	4½%	4½%	4½%	4 — 4½	4 — 4½	..	..	..	5 0 0
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	£ 5	4½%	4½%	4½%	4½%	3⅝ — 4	3⅝ — 4	..	..	..	5 12 6
445,786	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	96 — 99	96 — 99	..	..	..	4 10 11
49,486	Chelsea Electricity Supply, Ord.	£ 5	6 %	6 %	6 %	6 %	2⅞ — 3⅛	2⅞ — 3⅛	..	..	..	6 8 7
175,000‡	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	6 %	6 %	6 %	6 %	9½ — 10½	9½ — 10½	9⅝	..	..	5 17 1
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	12 — 13	12 — 13	..	..	..	4 12 4
400,000‡	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	122 —125	122 —125	..	..	..	4 0 0
800,000	Do. 4½ % 2nd. Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
40,000	County of Durham Electrical Power, Ord.	£ 5	£8 7 0	4 %	4 %	2 %	2½ — 3	2½ — 3	..	..	..	3 6 8
50,000	Do. do. do. 5 % Pref.	£ 5	5 %	5 %	5 %	5 %	3⅝ — 4⅛	3⅝ — 4⅛ xd	..	..	..	6 1 3
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4½%	5 %	5 %	5 %	7⅛ — 8⅛	7⅛ — 8⅛	..	..	— ⅛	6 1 3
40,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10⅜ — 10⅝	10⅜ — 10⅝	10⅜	..	..	5 10 4
400,000‡	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	107 —110	107 —110	..	..	..	4 1 10
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	4½%	99 —102	99 —102	..	..	..	4 8 3
80,000	Edmundson's Electric Corporation, Ord. Shares	£ 5	7 %	4 %	Nil	Nil	⅛ — ¼	⅛ — ¼	..	..	..	Nil
80,000	Do. do. 6 % Cum. Pref.	£ 5	6 %	6 %	3 %	Nil	¾ — 1	¾ — 1	..	..	..	Nil
433,000	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	4½%	59 — 66	59 — 66	..	..	..	6 16 4
$8,150,000	Electrical Dev. Co. of Ontario, 5% 1st Mtg. Gold Bnds.	$500	..	..	..	..	84½ — 87½	83¾ — 8 ½	..	..	—1	..
10,000	Folkestone, 1 to 10,000	£ 5	5½%	5½%	5½%	5½%	4⅝ — 5⅛	4⅝ — 5⅛ xd	..	..	..	5 4 9
10,000	Do. 5 % Cum. Pref., 1 to 10,000	£ 5	..	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛ xd	..	..	..	4 10 0
90,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	97 —100	97 — 100	..	..	..	4 10 11
15,000	Hove, 1 to 15,000	£ 5	8½%	9 %	9 %	8½%	6 — 6½	6 — 6½	..	..	..	6 10 9
$1,335,000	Kaministiquia Power Co., 5 % Gold Bnds.	..	..	..	..	..	94 — 96	94 — 96	94⅝	91½	..	..
21,000	Kensington and Knightsbridge Electric Ord.	£ 5	12 %	10 %	10 %	10 %	7⅞ — 8⅜	7⅞ — 8⅜	..	..	..	5 14 3
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	94 — 97	94 — 97	..	..	..	4 2 6
10,000	London Electric Supply Corporation, Limited, Ord.	£ 8	8 %	4 %	4 %	2½%	⅞ — 1⅛	⅞ — 1⅛	..	..	..	5 8 1
70,000	Do. do. do. 6 % Pref.	£ 5	6 %	6 %	6 %	6 %	4¼ — 4⅝	4¼ — 4⅝	4⅝	..	..	6 9 9
74,895	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4½%	89 — 92	89 — 92	91/3	..	..	4 17 10
200,000	Metropolitan Electric Supply, 1 to 100,000	£ 5	10 %	10 %	8 %	6½%	4⅛ — 4⅜	4⅛ — 4⅜	90⅜	90⅛	..	4 17 10
78,121	Do. 4½ % Cum. Pref. 1—71,106	£ 5	4½%	4½%	4½%	4½%	4⅛ — 5	4⅛ — 5	92/6	..	..	6 16 10
220,000‡	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	105 —109	105 —109	106⅛	105½	..	4 12 4
250,000‡	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	84 — 89	84 — 89	..	..	..	4 2 7
$8,000,000	Mexican Electric Light Co., 5% 1st Mtg. Gold Bnds	$	5 %	5 %	5 %	5 %	90 — 91	89 — 90	90⅛	89½	—1	8 18 8
$13,585,000	Do. Light and Power Co., Ltd., Common	$100	..	..	..	..	80½ — 81½	77 — 78	81¼	77	—3½	5 9 11
$1,500,000	Do. do. 7% Cum. Pref. Stk.	Stock	..	..	..	..	112 —113	112 — 113	113	112½	..	..
$12,000,000	Do. do. 5% 1st Mtg. Gold Bnds.	..	..	..	..	..	91½ — 92½	90⅜ — 91⅜	92	91½	— ⅜	..
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	94 — 97	94 — 97	96½	96	..	4 12 9
87,500	Newcastle-on-Tyne, 1 to 87,500	£ 5	8 %	8 %	8 %	8 %	5⅜ — 5⅝	5⅜ — 5⅝	..	..	..	7 19 2
87,500	Do. 5 % Pref., 1 to 87,500	£ 5	5 %	5 %	5 %	5 %	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..	4 6 11
10,852	Notting Hill Electric Lighting	10	7 %	7½%	7½%	7½%	11⅞ — 12⅜	11⅞ — 12⅜	..	..	..	5 17 8
20,000	Oxford, 1 to 96 and 407 to 20,310	£ 5	7 %	7 %	7 %	7 %	5⅝ — 6⅛	5⅝ — 6⅛	..	..	..	5 14 3
50,000	Do. 4 % Debt Stock	100	4 %	4 %	4 %	4 %	95 — 99	95 — 98	..	..	..	4 1 8
119,694	River Plate Elcty. Co. Ord. Nos. 1 to 120,507	1	..	..	2½%	..	1⅜ — 1⅝	1⅜ — 1⅝	28/9	22/9	+ 1/32	..
100,000	Do. do. 6% Non Cum. Pref. Nos. 1 to 100,000	1	6	6	6	6	1/16 — 1/16	1/16 — 1/16	..	..	..	..
194,634	Do. do. 5% Deb. Stk. Red.	100	5	5	5	..	99 —101	99 — 102	99⅛	..	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	£ 5	14½%	12½%	10 %	10 %	7 — 8	7⅛ — 8⅛	8	..	+ ⅛	6 11 3
20,000	Do. do. 7 % Pref. 30,081 to 40,080	£ 5	7 %	7 %	7 %	7 %	6¾ — 7⅛	6¾ — 7⅛	6⅞	..	..	4 16 7
150,000‡	Do. do. 3½ % Deb. Stock Red.	100	3½%	3 %	3½%	3½%	86 — 90	86 — 90	87	..	..	3 17 9
12,000	Smithfield Markets Electric Supply, Ord.	£ 5	4 %	4 %	Nil	Nil	⅜ — ½	⅜ — ½	..	..	..	Nil
60,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	68 — 72	68 — 72	..	..	..	5 11 1
65,000	South London Electricity Supply, Ord.	£ 5	4 %	4 %	3 %	4 %	2⅜ — 2⅝	2⅜ — 2⅝	..	..	..	7 5 5
120,000	South Met. Elec. Lt. & Power, Ord.	£ 1	Nil	2½%	2½%	2½%	⅜ — ½	⅜ — ½	..	..	..	4 0 0
117,968	Do. do. 7 % Pref.	£ 1	7 %	7 %	7 %	7 %	1/16 — 1/16	1/16 — 1/16	20/-	13/9	..	5 12 0
200,000	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	100 —103	99 —101	..	..	—1½	4 9 1
80,000	Urban Electric Supply, Ord.	£ 5	5 %	5 %	5 %	5 %	⅛ — 1	⅛ — 1 xd	..	..	..	20 0 0
50,000	Do. do. 5 % Cum. Pref.	£ 5	5 %	5 %	5 %	5 %	1⅛ — 2⅜	1⅛ — 2⅜ xd	41/3	40/-	..	10 10 6
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	4½%	4½%	4½%	4½%	82 — 85	80 — 83	..	..	—1	5 8 5
800,000	Victoria Falls Power Co., Pref. Nos. 1 to 800,000	1	..	..	..	..	⅜ — ½	3/16 — 1/4	..	..	..	..
110,000	Westminster Electric Supply, Ord.	£ 5	12 %	12 %	12 %	10 %	7⅞ — 8⅜	8 — 9	8 1/16	..	+ ⅛	5 11 1
81,279	Do. do. 4½ % Cum. Pref. (Original 5 %.—Red. to 4½ % from 31st Dec., 1905)	£ 5	5 %	5 %	4½%	4½%	5 — 5⅛	5 — 5⅛	..	..	..	4 1 10

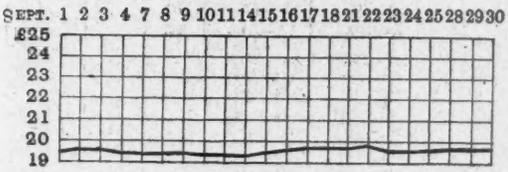
* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange. § Interim Dividend.

Bank rate of Discount 2½ per cent. May 28th, 1908.

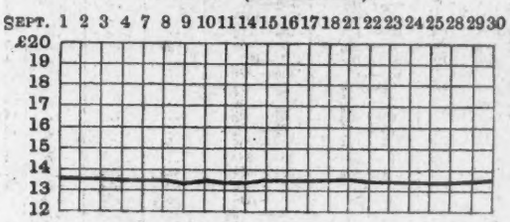
METAL MARKET.

Fluctuations in September.

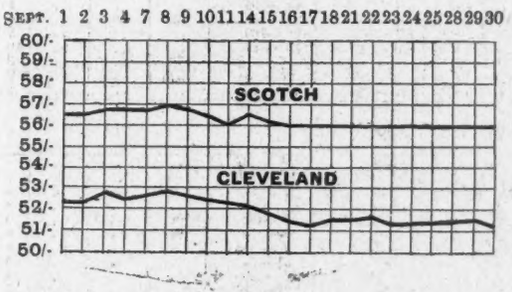
SPELTER (G.O.B's.).



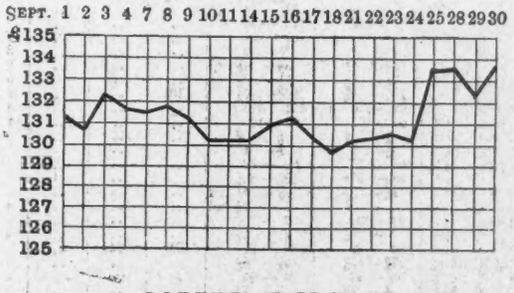
LEAD (ENGLISH).



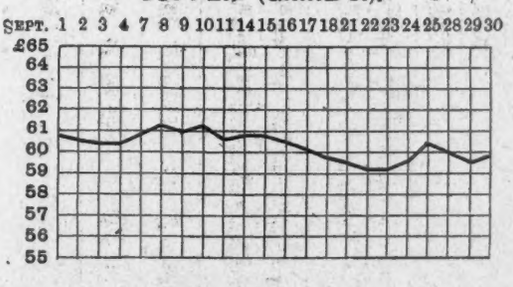
IRON.



TIN.



COPPER (G.M.B's.).



Portable Searchlight.—The Antwerp Telegraph Company of the Belgian Engineers employs a petrol-electric automobile of the "Auto-Mixte" type to haul a searchlight on a carriage, and to feed the arc when halted, the combination obviously possessing advantages for both purposes. The arc takes 110 amperes at 80 volts, and is supplied from the battery of 40 cells through flexible conductors, while the operator controls the motors which direct the searchlight from a point at some distance from the latter, also with the aid of flexible cables, wound on drums.

CATALOGUES.

By W. O. HORSNAILL, A.M.I.Mech.E., A.M.I.E.E.

The preparation of a catalogue, if any considerable number of products has to be dealt with, is a costly undertaking, and it is, therefore, highly desirable that the best possible results should be secured for the outlay involved.

Three definite aims should be kept in view whilst compiling a catalogue:—Firstly, the promotion of confidence in the goods described; secondly, the concise presentation of particulars so that the buyer knows exactly what he will get for his money; thirdly, the setting forth of approximate prices for the products described.

Of these three functions the promotion of confidence in the prospective purchasers is of the greatest importance, and certain definite principles may be laid down for effecting this result.

A section of the catalogue must be reserved for each line of manufacture beginning with what the Americans call a "straight talk" on the subject.

This "talk" should not start with any mention of the firm's products, or even of their name, but it may with advantage contain a brief history of the development of the goods in question, followed by a comparison of the features appertaining to different types. This system leads up to the reasons why a certain design has been adopted by the firm, and these reasons should be supplemented by reference to the difficulties which have been met with in perfecting the product and the methods adopted to overcome them.

Almost all machines and appliances made by manufacturing engineers lend themselves to this treatment, but the matter must be readable even for those having no technical knowledge of the subject.

Many catalogues are to be met with, in which attempts have been made to introduce the subject on the lines suggested above, but the manner of presenting the information fails to interest the reader, and the space occupied in this way is consequently wasted.

Calculations may be introduced to bring out certain points, but the figures must be of the simplest possible description, or the reader will not take the trouble to grasp them.

Following this lecture, a technical description of the machine or appliance should be set forth with diagrams, illustrations and information as to the materials used for the various parts.

Here, also, illustrations of details should appear, if this course be necessary, to show any special construction for which advantages are claimed.

This portion of the catalogue should be completed by illustrations and particulars of the application of the product to various representative purposes, supplemented by a list of purchasers and the total number sold up to date, together with the percentage of repeat orders.

The total number sold must, however, be large enough to indicate good results in view of the period which has elapsed since the placing on the market of the machine or appliance in question.

Testimonials may be introduced at this point with advantage for inspiring confidence in private customers, but if the sales are entirely to the trade, it is doubtful whether testimonials have any appreciable effect.

It may be contended that the above procedure entails the giving away of full information to trade rivals. The answer to this contention is that your competitors can always find out exactly what you are doing, and the giving of full particulars is very effective in promoting confidence in prospective purchasers.

In the old days when workmen, foremen and staff remained in the same employ all their lives, and when engineering knowledge was entirely gained from experience, it was possible for certain firms to accumulate data and to devise processes, a knowledge of which could be confined to themselves and their employés.

These conditions have long since passed away, and with the constant changes in staff and workmen now obtaining, together with more scientific methods of investigation, it is

impossible to keep the knowledge of design and processes from trade rivals.

We now come to the presentation of sizes, particulars and prices, although in some cases certain technical data may be introduced with advantage before tabulating this information. For instance, a catalogue of surface condensers should contain tables, at this point, showing the cooling surface and quantity of water required, within certain limits of temperature, to give various absolute pressures. Information given at this stage should, however, be confined to any data which may be necessary to enable the purchaser to select the correct size of machine, and which cannot conveniently be included in the tables giving sizes and prices.

Electric motors are amongst the most difficult products to catalogue, owing to the use of each machine for different speeds and voltages. The particulars required are so numerous that a separate table is usually reserved for technical data, leaving the prices and dimensions to follow in, perhaps, two other lists.

For heavy or bulky goods, net and gross weights, together with shipping sizes must be given, and for many types of machinery the overall dimensions should also be tabulated.

Many manufacturers are averse to giving lists of dimensions, for the reason that no modifications can be made without revising the catalogue. The answer to this objection is that the products should be thoroughly tested and perfected before the catalogue stage is reached, and that no alterations ought to be required until the goods have been manufactured in a definite form for a considerable period.

Improvements must be introduced from time to time, but when they become necessary, a complete line of products should be revised at once, entailing a new catalogue, with revised illustrations, dimensions and prices.

Moreover, tables of dimensions inspire confidence by giving the impression that the sales are so large as to necessitate this course to avoid abnormal correspondence. If a purchaser has to write for particulars, he is apt to think that the article required has not been made before, or only in small quantities. Then again, overall dimensions are often useful to contractors and consulting engineers when working out alternative schemes. In such cases a catalogue giving full particulars is used in preference to a list in which the dimensions and weights are omitted, the trouble and delay incurred by writing for the desired information being inadmissible.

Tables giving particulars, dimensions and prices, should be very clearly printed with heavy dividing lines, the guiding figures being in heavier type than the dimensions or other particulars.

Many firms make a practice of printing prices in red, and this plan is strongly recommended.

The prices should be as correct as the fluctuations in material will permit of. The plan of issuing price lists subject to large discounts is a source of annoyance to everyone who has to use them. It is difficult to understand, for example, what useful object can be served by stating figures subject to 47½ per cent. discount.

A good catalogue will be picked out for use by contractors and others when designing various schemes, and the advertisement gained in this way is of great value.

A few pages should next be devoted to an illustrated description of the works in which the products are made, stress being laid upon the facilities for receipt of raw material and the dispatch of the finished product, as well as upon the care taken throughout to secure good results at the least possible cost. Provision for the comfort and recreation of the employé should also be touched upon, together with illustrations of mess rooms, libraries, cloak rooms or other arrangements in furtherance of this object.

Systems of payment to secure a larger output whilst at the same time benefiting the workmen, should be explained, and if a suggestion system is in force, particulars should be given.

This description of the works must be of an interesting nature, such as would be read by any person of average intelligence, but with no knowledge of the manufacture in question.

The effect upon the prospective purchaser after reading such an account of the factory will be a conviction that :—Firstly, he will get the best value for his money ; secondly, that he is in touch with a firm who treat their workmen with fairness, and are therefore likely to be straightforward in their dealings with customers.

Further confidence is inspired by the inclusion at the end of a catalogue of a few tables and data in connection with the product put forward. In compiling this portion of the work do not be afraid of giving away information ; the confidence inspired far more than counterbalances any disadvantages which arise from imparting your experience to competitors.

Take, for instance, a catalogue of worm gear. Makers of this type of apparatus are sometimes chary of telling their customers how the ratings are arrived at. This is a mistaken policy, the fullest possible results from the firm's experience should be given and supplemented, if necessary, with data from other sources.

It may be urged that such a course enables prospective purchasers to make worm gears for themselves, and this fact cannot be disputed, but it must be remembered that any firm of engineers requiring a large number of similar gears will lay down their own plant for making them.

On the other hand, confidence will be inspired in purchasers of small quantities, who cannot manufacture for themselves as cheaply as they can buy, although they have the required data to work upon.

The whole essence of manufacturing engineering depends upon being able to produce more cheaply than your customers, but when the latter are also engineers, this principle is confined to small quantities.

Loose leaves should only be used in response to definite inquiries, and they should be gummed to the covering letter, with which they will then probably be filed.

The size and get-up of catalogues is of great importance, the dimensions should never exceed 13 in. × 8 in., as filing arrangements seldom contemplate anything larger than foolscap.

The paper should be of good quality, with glazed surface to suit the illustrations which are now always made from process or half-tone blocks taken from photographs. A red border line round each page gives a neat finish, and the covers should be carefully designed by someone skilled in this class of work.

A table of contents or an index is obviously necessary in most cases.

The treatment advocated above must be varied to suit different conditions, but the general principles remain the same, and they should be followed out as nearly as the conditions permit of.

A catalogue got out upon the above lines should, and will, form a book of reference upon the products dealt with, the catalogues of many well-known firms being used in this way with continual benefit to their compilers.

PUBLIC LIGHTING BY INCANDESCENT LAMPS.

The gradual extension of electric lighting cables in the suburbs and side streets of every town of moderate size, and the recent improvement in the lighting efficiency of lamps, have made competition with ordinary street gas lighting one of the most important and interesting problems arising in connection with the supply of public illumination. This is particularly interesting where the problem of lighting newly-built streets and partly-built suburbs is met with. In the case of arc lighting, which is usually confined to main roads where there is a straight run of cable and the return on the initial outlay is practically guaranteed, the points to be considered are generally more of an engineering than a financial nature ; the predominant factor is rather the question of the system to be adopted than that of the cost and return. When, however, the question arises of lighting a whole district with lamps of smaller candle-power and a correspondingly low return, there are many details to be entered into in order to obtain a good financial result. Many of the lamps will be in positions which call for outlay on mains

with no other return than the yearly payment derived from the use of the lamps. In the case of a company this state of affairs is further complicated by the fact that the contract may be only for a limited time, with the risk of being beaten by the gas company at the expiration of the contract. In corporation work, of course, the engineer has often a chance to select the district in which to start his system, whereas in the case of the company any district selected by the municipal authorities has to be taken, with all its attendant disadvantages.

The lighting of a moderately good class modern suburb and the illumination of a town of some age present two very different problems. In the first case, the modern suburb will be laid out with long straight roads, through which mains may be profitably laid. In this case a sub-station system will probably be required. In the other case there will be innumerable small passages, alley-ways and "no thoroughfares," where the chance of any return on the mains is very remote, and the cost of the service to many of the lamps will preclude the obtaining of any reasonable profit. Side roads and passages of main roads lit by arc lamps often involve a long run of cable, especially where the lighting circuits are kept separate from the ordinary town supply. In this case, however, it is often possible to work relays off the arc circuit.

This brings us to the principal points to be considered when a new system is being designed. It is essential to find out whether it is better to run the lamps off the existing or intended low-pressure network, or to lay a separate system of mains, controlled either by relays from the generating station, by time switches at convenient centres, or by switches which would be closed by the men themselves before starting their rounds of inspection, and opened again at daylight. It is obvious that the first system is cheaper as regards first cost, but is expensive as regards maintenance, inasmuch as the time taken to switch the lamps on and off forms a very serious revenue charge, with the additional disadvantage that many lamps have to be lit before time, in order that the last lamp visited may be in operation before dark. In the case of an independent system of mains for street lighting, a very considerable outlay must be faced, because the distance apart of the lamps (say, 60 to 100 yd.) means the laying of a long length of main, even where all the circumstances of such a scheme are favourable. On an alternating-current system such systems can be most conveniently fed from a sub-station or box, where a relay is installed which can be operated from the generating station, and in the case of a direct-current system, the circuits can be operated in a like manner from suitably placed feeding points. With such a system it is only necessary to get a man to cycle round the circuits to see that all the lamps are on, which method practically limits the time spent on lamps to that taken up by cleaning globes and renewing lamps.

In the case of a system where the lamps are taken directly off the low-pressure network, there is the necessity of a reliable and easily worked switch, strong enough to stand being operated by means of a stick. This switch should be unobtrusive in appearance, as otherwise it will be sure to attract the attention of small boys, who will always be found ready to switch off a lamp when an opportunity occurs. This very annoying propensity especially affects a supply company when fines are enforced for every hour that a lamp is out of operation during schedule times of illumination. There is always the constant liability that the circuits will not be switched on in time, owing to the perversity of uncontrollable occurrences, such as men on the operating staff being taken ill, cycle tires puncturing when mounted operators are used, and many trivial details of this kind, which all incline the engineer to the choice of an independent system. Moreover, as regards switching off in the early hours of the morning, especially in the summer season, there is always a tendency on the operator's part to be late rather than early unless a careful check is kept on his time—a fault which improves the figure per unit generated, but not per unit sold.

In the case of an independent system—and, indeed, to a certain extent, of any system of street lighting by incandescents—the problem arises of supplying a small amount of current over considerable distances, say a long run down a side street. For example, it may be necessary, in a blind entry of 100 or nearly 200 yards length, to light two 100-watt lamps taking, say, 1 ampere at 200 volts. If an existing run of piping is to be used, it is, perhaps, doubtful whether the size of the cable required, if lead-covered, is strong enough to stand with certainty the strain of a long pull. Moreover, if armoured cable is laid, very careful handling is required in order to ensure that the small cable is not damaged by its own armour. Where lead-covered cables are used, trouble also arises as regards the end connection on to the fuses in the top of the lamp column. The small space allowable makes it a very difficult matter to undertake repair work on the switch and fuses should they require renewal or alteration, as must occasionally occur, even with the best of workmanship. On a system of this nature, where the expense of a cover over each box is prohibitive, it is a good plan to have disconnecting boxes at all convenient or important points, such as street corners, which can be easily opened for testing purposes, so as to localise as quickly as ever possible a fault on the network. This is advisable, in view of the fact that it will be found absolutely necessary to keep down the capital cost as much as possible, owing to the low price obtained per lamp; and in the case of an underground system the heavy outlay for trench work and reinstatement charges will be found to be very high in proportion to the revenue obtainable.

In the event—rare in this country—of the work being carried out by means of overhead distribution, there is far more chance of a profitable return being obtained, inasmuch as the capital cost is greatly reduced. The poles obviate the cost of separate lamp standards, and there is always a chance of getting cheap extensions to low-pressure mains along poles originally erected for public lighting only. Moreover, in many cases overhead services may be run off the street lighting circuits for a supply during lighting hours only, such services costing only about a quarter of the ordinary underground services. In such cases it is policy to promise an all-day supply as soon as a certain number of consumers are obtained on each main. In many cases it may be necessary to adopt a mixed system, one portion of the circuits being switched on from the station by means of relays, other lamps being operated by time switches, and yet others by hand. It is difficult without inspecting the actual local conditions to determine which system will pay best, but the considerations noted in the foregoing notes should be most certainly taken into account by an engineer before deciding on the method to be adopted for competing with gas lighting for street illumination.

AN ENGINEER'S CERTIFICATE.

[FROM OUR LEGAL CONTRIBUTOR.]

UPON what grounds may an engineer's certificate be dispensed with? As a general rule, in contracts for buildings and large engineering works, the architect or engineer, as the case may be, occupies the position of arbitrator between the parties.

It is clear law that when a building contract provides that the builder is to obtain the architect's certificate in writing before payment of any money under the contract, it is a condition precedent to the builder's right to sue upon the contract that such certificate be given by the architect, and no claim can otherwise be made for payment under the contract. The Court has no right to dispense with that which the parties have made a condition precedent, unless, of course, there has been some conduct on the part of the architect or the employer which may make it inequitable that the condition precedent should be relied on. If nothing of that kind has happened, then the parties are bound by that which they have made a condition precedent ("Emden's Building Contracts," fourth edition, page 101). Work, therefore, which has been done, but not to the satisfaction of the architect or engineer, cannot be charged for. When the certificate, however, has been given, the person who gave it is *functus officio*, and he cannot vary or alter it. The employer is not responsible for any

misconduct of his architect or surveyor in refusing to certify, not brought about by his instrumentality or interference. Further, there can be no claim in equity for the work done, upon the mere ground of the architect's refusal of the certificate, unless the case can be brought within the jurisdiction of the Court, on the ground of fraud or gross misconduct amounting to fraud, on the part of the architect in refusing it, or, it seems, of his wilful neglect or absolute incapacity to perform his duties. Relief, therefore, will be given where there is collusion dealing and concert between the employer and the person whom he has appointed engineer, for the purpose of injuring the contractor or defeating his claim. Another case in which the builder or contractor may sue for the cost of works executed without having obtained a certificate, is where the employer is himself guilty of fraud. Thus the employer would be guilty of fraud if he were to induce the engineer to withhold his certificate or alter it after it had been granted. Such conduct would be neither more nor less than an attempt on the part of the employer to bribe a judicial tribunal. But it cannot be too strenuously emphasised, that unless the employer is himself guilty of fraud, or of taking fraudulent advantage of the misconduct of the engineer in refusing to certify, he cannot be held liable. Where there is fraud on the part of the employer, the contractor can enforce his claim, independently of any certificate, or he can sue the architect or engineer for fraud.

We desire to emphasise this point, owing to the fact that the case of Kellett *v.* New Mills U.D.C., which is reported in the second volume of Mr. Hudson's "Building Contracts," at page 330, might lead the unwary to think that a builder or contractor can bring suit against the employer, merely because the engineer or architect has never certified. In that case the plaintiff agreed to do work for the defendants to the satisfaction of an engineer, upon whose certificate the defendants agreed to pay. The jury found that the works were completed in December, 1897, but that no certificate of completion was ever given. They also found that the engineers never addressed themselves to determine and certify that the works had been completed, or what was the sum due to the plaintiff, but that they wrongfully refused or wrongfully and unreasonably delayed so to determine and certify; *and that the defendants were aware of such refusal or delay and took advantage of it to refuse or unreasonably delay payment.* Upon these findings Mr. Justice Phillimore decided that the absence of the certificate was no bar to the action. The words underlined are the all-important findings of the jury which decided this case.

In wilfully taking advantage of the engineer's misconduct, it is clear that the employers were guilty of that which was legal fraud. It was submitted, however, that unless the jury had so decided this issue, there must inevitably have been a verdict for the defendants.

Not only must a certificate be obtained if the contract makes it a condition precedent to payment, but all the formalities in relation thereto must be strictly observed. In Lorden and Son *v.* Pryce (Emden's Building Contracts, 4th edition, page 664) a building contract contained the usual clause referring questions which might arise to the architect, and another clause (18) requiring that orders for extras were to be signed by the secretary and treasurer and countersigned by the architect. The builder having completed the work, the architect issued a final certificate which apparently included certain extras which had not been signed for by the secretary and treasurer. It was held that the architect having no power either by direction or by consent or waiver to get rid of Clause 18, the plaintiffs were not entitled to recover the cost of extras, although included in the final certificate. It is also very difficult to set aside an arbitration clause on the ground that the arbitrator is biased. Thus in Cross *v.* Leeds Corporation (1902) 2 H. 369 a named arbitrator, who was an official of the Leeds Corporation, wrote a letter in which he said that the claim of the contractors against the Corporation was outrageous. The contractors brought an action against the Corporation, which the Corporation applied to have stayed pending the arbitration; the contractors opposed this. It was held that the arbitrator was not disqualified.

The following passage from the judgment of Lord Collins (then Master of the Rolls) is not unimportant. Dealing generally with the position of an engineer or architect, he said: "The parties have not agreed—that is the plain English of it—for an impartial arbitrator, because the person they have agreed upon as arbitrator is one who, it may be pre-supposed, may have formed, to the best of his ability, and with all the information that was at hand, an adverse opinion to one of the parties upon the points in dispute."

In Wallace *v.* Brandon and Byshottles U.D.C. (1903), 2 H. 392, a contract provided that (1) the works shall be *completed* in all respects . . . on or before the 16th day of December, 1901, to *the satisfaction of the surveyor* . . . to be testified by a certificate under his hand, and in default of such completion the contractor shall forfeit and pay to the District Council the sum of one pound for each day during which the works shall be incomplete after the said time . . . as and for liquidated damages; (4) . . . the contractor shall be paid by the Council at the rate of 80 per cent. of the value of the work done in each month, and the balance one month after completion of the contract. Provided that the District Council shall not be required to pay to the contractor any sum exceeding the value as valued by the said surveyor or other officer, of so much of the works as shall have been executed by the contractor during the preceding month. It was held that a certificate by the surveyor that the work had been *completed* to his satisfaction, was a condition precedent to the payment of the retention money.

THE LAY-OUT OF CENTRAL STATION PLANT WITH A VIEW TO RELIABILITY.

By J. SALISBURY and W. S. BURGE.

The excellence in design and manufacture of our present-day central station equipments leaves very little to be desired as regards the reliability of any individual piece of plant, for the keen competition between rival manufacturers, coupled with the stringent specifications of our consulting engineers, has effected the production of standard plant that has reached a high degree of excellence, as regards both reliability and efficiency. There are, however, and probably always will be, many causes of failure due to injudicious selection of plant to suit the conditions of supply together with the natural environment of the power station, and to careless lay-out of the various sections of the plant itself; and it is the object here to touch briefly on several of these questions.

It is not possible to lay down any hard and fast rules in central station design, as the determining factors are, to a large extent, governed by existing circumstances; but there are such questions as boiler house auxiliaries, the complete unit system, and the lay-out of the main switchgear, that are of vital importance as affecting the reliability of all power station design.

One of the most serious sources of trouble, although, perhaps, not the most frequent, is the question of boiler feed, for the failure of the feed water supply must necessarily mean the shutting down of all the steam plant, and probable damage to the boilers due to steaming them under emergency conditions. With the possibility of such trouble in view, one cannot be too careful in duplicating both the source of feed-water supply, and the means of delivery to the boilers. Whatever the size of the station may be, one is fully justified in the expense of having both steam and electrically-driven feed pumps, so that in the event of a failure of one, the other can be requisitioned. It should be remembered that great difficulty has often been experienced in trying to force an inadequate boiler installation fed by steam-driven pumps when the steam pressure has, for some reason or other, become abnormally low. It is under such conditions that one will fully appreciate the electrically-driven feed pumps that can be used quite irrespective of steam conditions. In its early stages the electrically-driven feed pump was for a long time regarded as being less reliable and more erratic in its behaviour than the steam-driven pump, but there is little question as to its high efficiency and low

maintenance costs, so that a combination of electrically-driven pumps with steam-driven pumps as stand-by, is by far the most efficient and reliable arrangement.

The old trouble due to priming can generally be traced to careless operation in coupling up fresh boilers or sections of steam range, but in certain instances the trouble may be due to faulty arrangement of the steam range drainage. It is no uncommon thing to find the steam traps fixed right at the bottom of the drain pockets in a range, instead of being connected a few inches above the bottom, in order that the sludge which collects in the drain pocket may not choke up the steam trap. There should always be a separate drain pipe fitted with a cock at the very bottom of the pockets, so that this sludge may be blown out when necessary.

For stations of large capacity, perhaps the most reliable lay-out of the plant is to be obtained by the adoption of a modified form of the complete unit system. By this term is meant an arrangement such that, under normal conditions, the station capacity of the plant is split up into several completely isolated units, but in which, under abnormal conditions, certain interconnections between the units may be made so that a fault on any one unit can be isolated, and the function of the faulty piece of plant may be taken up by the remaining units. This system certainly entails extra capital expenditure in securing the means of interconnection; also, in stations of very large capacity, there will probably be extra expense involved in boiler house buildings, as the boilers can be better apportioned to their respective units by building separate boiler houses at right-angles to the engine room. Each of these boiler houses should feed in parallel on to one main steam range running the length of the engine room, but there should be sectionalising valves dividing the main range between the various batteries of boilers, so that any one steam unit may be fed from its own battery of boilers alone or from any of the others.

The source of motive power for driving the auxiliary equipment of each unit is a question of great importance, as every precaution must be taken so that there may be no possibility of a failure along the whole line of auxiliaries for any one unit, as such failure must necessarily mean the shutting down of that unit.

With a view to avoiding such a contingency, the supply for all the units should certainly be made interchangeable.

The safest means of securing this is to feed each separate line of auxiliary equipment from a low-tension distribution panel, each panel being mounted opposite its own unit and fed from its own transformer (assuming the station to be for A.C. supply), but switches should be provided for feeding the L.T. bus-bars on each of the distribution panels from one or more of the other unit transformers. The switches between the L.T. side of the transformers and the distribution panels should certainly be non-automatic, for the option of isolating all the auxiliaries of any one unit, owing to a fault, should be left to the discrimination of the engineer-in-charge rather than to the action of any automatic switching apparatus.

It may, perhaps, be thought inadvisable to feed the distribution panels through a non-automatic switch, but where the distribution panel serves such an important function as that of supplying the motive power for all the auxiliaries of, say, a 5,000-KW. unit, it would be better to risk burning out the auxiliary transformers than shutting down all the auxiliaries for one complete unit, due to a fault that might trip a switch but would otherwise do very little damage.

As the protection on the L.T. side of the transformers is non-automatic, there should be an automatic time limit overload switch on the H.T. side, with a high setting to the time element, so that in the event of a fault on any of the transformers the effect will not be serious on the station bus-bars. It is doubtful whether the complete unit system without thorough means of interconnection would result in successful operation, particularly if the station is run very near its full capacity, as any mishap causing one of the main units to be put out of commission would throw out a lot of sound plant that might otherwise have been in use.

With carefully arranged interconnection, however, the complete unit system undoubtedly affords the best arrangement of plant for stations of large capacity, and the chances of any serious interruption to the supply under such conditions are very remote.

A not uncommon source of trouble in A.C. stations is the failure of the alternator excitation, and one cannot be too careful in making provision whereby any machine may be excited from at least two different sources. It is surprising how many important stations there are where no provision is made for duplicating the source of excitation. In stations where there is a battery, it is always advisable to take tappings off at the voltage of excitation, and to use this as a duplicate source in case of emergency. Where each unit has its own direct-coupled exciter, the switching arrangements of the exciter circuits should certainly include a means whereby any alternator can be excited from the exciters of the other units, by means of double-pole switches interconnecting the alternator fields of the various machines, so that in the event of any exciter failing, its alternator field may be fed from the exciters of the other units. With this arrangement, there must necessarily be a means of regulation on the alternator field circuit itself.

The practice of connecting the main generating units on to the bus-bars, irrespective of any automatic elements, has for some time been open to question, but from experience gained in some of the most important stations in this country and in the United States, it appears that this practice is not liable to lead to undue damage of any of the generators, and there is certainly eliminated the risk of a generator being tripped out of circuit due to a momentary disturbance in the system, or to some mechanical fault of the prime mover, that might have been rectified with the machine still on load.

It is only right that the source of supply should be the very last to be disconnected owing to faulty conditions, and in view of the perfect means that we now have for automatically isolating any faulty circuits outside the generating station, there is a very strong argument for having the source of supply coupled on to the bus-bars without any automatic element. Any trouble in a power station, necessitating the switching out of a generator, usually makes itself known to the attendant in the form of smoke or sound on the prime mover or the generator, and one may then use discretion as to the advisability of switching-out.

THE CONNECTION BETWEEN BREAKDOWN VOLTAGE AND TEMPERATURE.*

It is well known that when an alternating voltage, such as is usually employed for testing purposes, is applied to any insulating material for an appreciable time, a temperature rise results. For a given voltage, breakdown occurs when the insulation resistance of the material falls to a certain definite value, and, with solid insulators, the insulation resistance falls steadily with increasing temperature, so that a complex relation exists between the breakdown voltage and the time of application, cooling arrangements, &c. When the breakdown test is made in the ordinary way by steadily raising the voltage in a comparatively short time until breakdown occurs, the figure obtained for the breakdown voltage is liable to be too high on this account. For practical purposes, it would seem to be more correct to increase the voltage very slowly so as to enable a steady temperature to be reached at each stage. With a view to investigating this point more closely, Prof. A. Grau, of Vienna, recently carried out the following experiments:—

The tests were made with a variable-voltage 8-KW. transformer supplied at 100 volts, 44 cycles, and giving up to 100,000 volts, measured by an electrostatic voltmeter. The first materials tested were stabilit and ebonite, in the form of sheets 50 cm. × 50 cm. × 2 mm. thick. Each sheet was coated on both sides with pieces of tinfoil of various sizes. The temperature was measured by means of a nickel-iron thermo-junction made up of ·4 mm. wires and connected to a milli-voltmeter calibrated to read temperature directly. In order to avoid the effect of draughts, &c., two of the tinfoil-covered insulation sheets were placed together, with the tinfoil patches superposed, and the thermo-junction, covered

* *Elektrotechnik und Maschinenbau*, July 5th, 1908.

with tinfoil, was placed between the two inside tinfoil sheets. The high-pressure supply was applied between the thermo-junction and the two outer tinfoil sheets.

The whole was supported horizontally on three insulators. Each voltage was applied until the temperature (measured every quarter of an hour) became steady, which usually occurred in something like an hour. The following table shows the results obtained with stabilit sheets having tinfoil coats 5 cm. in diameter.

Time from start.	Temperature at 10,700 volts.	15,000 volts.	19,500 volts.	25,000 volts.
15 min.	21·5° C.	28·5° C.	37° C.	66° C.
30 ,,	23	29·5	38	Broke down after 25 min.
45 ,,	24·5	30	39	when the temperature
60 ,,	24·5	30	39	had reached 84°.

These results are plotted in curve A, fig. 1, using the final steady temperatures. It will be seen that practical constancy is reached within an hour. During the last minute before breakdown a steady increase in current and fall in voltage was observed.

The temperature rise, and consequently the breakdown voltage, depend to a certain extent on the size of the tinfoil coatings. Thus, if the diameter of the coatings is

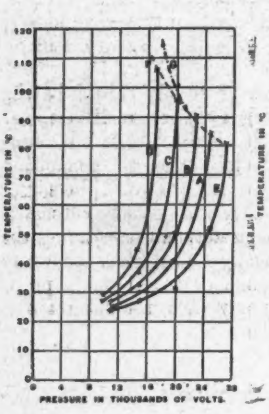


FIG. 1.

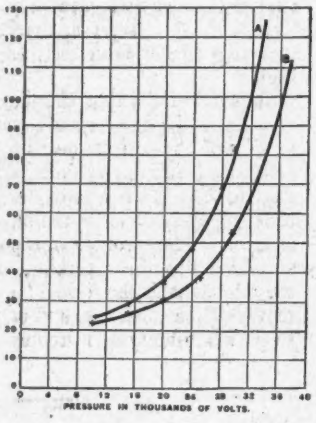


FIG. 2.

doubled, the volume of material subjected to the stress becomes four times as great, and the total heat developed is also four times as great. The top and bottom cooling surfaces also become quadrupled, but the cylindrical surface around the edge is only doubled, so that the cooling surface as a whole does not increase quite in proportion to the heat developed. This effect is shown by the following figures taken on similar stabilit sheets with coatings 10 cm. and 15 cm. respectively in diameter :—

With 10 cm. tinfoil coatings. Volts.	Temperature.	With 15 cm. tinfoil coatings. Volts.	Temperature.
11,000 ...	26·5° C.	10,000 ...	27° C.
15,000 ...	32·5° C.	15,000 ...	36° C.
20,000 ...	49° C.	20,000 ...	95° C.
23,000 ...	90° C.	Broke down after 67 minutes.	
Broke down after 9·1 minutes.			

These results are plotted in curves B and C, fig. 1.

In the case of the 10 cm. coatings the true breakdown pressure is obviously somewhat below 23,000 volts, since at this figure breakdown occurred after nine minutes, whilst the steady temperature would not be reached in much less than an hour. Curve D, fig. 1, shows the results of a similar test with 20 cm. diameter tinfoil coatings.

The effect of artificial cooling was next tried by replacing the tinfoil coatings by liquid electrodes, formed by pressing rubber-lipped metal boxes filled with soda solution against the sides of the plate under test. In this way the part of the plate covered by the liquid always kept cool, but the surrounding parts became heated, and breakdown always occurred in these heated portions from 5 mm. to 25 mm. outside the edge of the electrodes. In this way the stabilit sheets with 5 cm. electrodes showed a breakdown pressure lying between 30,000 and 35,000 volts.

The same results were obtained when massive copper electrodes 5 cm. in diameter and 8 cm. high were used in place of the liquid electrodes. When the whole sheet was immersed in oil, so as to keep it cool throughout, still higher breakdown voltages resulted.

Even where the natural cooling alone was accentuated by repeating the original test in air, but with only a single sheet instead of two superposed sheets, so that the air had free access to both tinfoil coatings (one of which covered the thermo-junction), a distinct increase in breakdown voltage occurred, as shown by fig. 1, curve E, for a 2-mm. stabilit sheet having tinfoil coatings 5 cm. in diameter.

On the contrary, when the insulation sheet was artificially heated by placing it in a box whose temperature could be kept steady at any desired value, the breakdown voltage was lowered as shown by the following figures for stabilit :—

Temperature.	Breakdown voltage.
86° C.	23,500
92° C.	22,000
100° C.	20,500
115° C.	18,500

The electrodes in this case were 5 cm. diameter metal disks, and the temperature was that of the air in the box, as measured by thermometer. The above figures are plotted in curve G, fig. 1, and it will be seen that they do not quite agree with curve F obtained for the independent series of tests previously described. The discrepancy is probably partly due to the inexactness of the temperature determined by the thermo-junction, and partly to the difficulty in determining the exact value of the voltage at which breakdown occurs.

Finally, experiments were made with high-pressure direct current. Two stabilit sheets, with tinfoil coatings 15 cm. in diameter, were tested in the way first described above, at 20,000 volts pressure. They showed no appreciable temperature rise, even after an hour's application—a result which has often been noticed before and has been ascribed to the absence of the so-called "dielectric hysteresis" in the case of direct current.

The writer repeated many of the above experiments on sheets of ebonite and sheets of glass with similar results. Thus, in fig. 2, curve A shows the figures obtained with ebonite sheets 2 mm. thick coated with tinfoil sheets 5 cm. in diameter. The test was carried out in air as described above (with two sheets superposed and the thermo-junction placed between them). The temperatures plotted are those attained after one hour when a practically steady state had been reached in all cases. Breakdown occurred after only eight minutes at 35,000 volts, so that the correct breakdown voltage is somewhat lower than this figure. Curve B, fig. 2, shows the same results for a single sheet of ebonite (both tinfoil coatings exposed to the air). In this case breakdown only occurred after an application of 39,000 volts for 35 minutes.

With 2 mm. glass plates the results obtained were somewhat erratic, partly because of irregularities in thickness and quality, and partly because the breakdown always occurred at the edges of the tinfoil coating, so that the thermo-junction could not give any exact idea of the temperature at the actual point of breakdown. The approximate breakdown pressure was 25,000 to 30,000 volts in this case.

Fires.—Early on Saturday morning a fire occurred on the premises of MESSRS. D. H. BONNELLA & SONS, in Kirby Street, Hatton Garden. The damage was confined to two floors. We understand that very little delay in the firm's business was occasioned, as arrangements were immediately made for carrying on the works.

On September 28th a fire occurred at 83, Queen Victoria Street, E.C., in the show rooms, workshops and offices of J. J. ROCHE AND CO., electrical engineers. The warehouse of Selig, Sonnenthal and Co., next door, suffered seriously from smoke and water, &c.

Canada.—According to the *Board of Trade Journal* a Toronto correspondent desires to get into touch with some first-class United Kingdom firms who may wish to increase their trade with Canada in all kinds of electrical equipment used in the generation, transmission and distribution of urban and suburban power. For further information application should be made to the High Commissioner for Canada, 17, Victoria Street, S.W.

THE CONTINENTAL ELECTRICAL ENGINEERING INDUSTRY.

German Works.

The activity of the Electricity Co. (formerly Lahmeyer & Co.), of Frankfort-on-Main, is stated in the directors' report for 1907-8 to have been substantially restricted to the administration and further development of the company's undertakings. It was not possible to dispose of any of the financial participations and securities, and thus the bank credit experienced a further moderate increase. As the Felten & Guilleaume-Lahmeyer Works Co. had called up the remainder of the unpaid amount on the new shares, the Electricity Co. now possessed £800,000 fully subscribed shares in the former undertaking. The gross profits from the working of lighting and tramway enterprises and from securities and interest amounted to £168,256, as compared with £175,158 in 1906-7, and the net profits were £80,077, as against £81,343 in the same periods respectively. A dividend has been declared at the rate of 7 per cent. on the share capital of £1,000,000, being the same as in the preceding year. In addition to the ordinary capital the company has in circulation 4 per cent. bonds totalling £89,500 and 4½ per cent. bonds reaching £879,500, and the undertakings which the company owns or is interested in are situated in various countries in Europe.

The firm of Brown, Boverie & Co., of Mannheim, the German subsidiary of the Swiss company of the same title at Baden, were able to secure satisfactory employment during 1907-8, although the directors' report states that many orders had to be accepted at depressed prices owing to the unfavourable situation of business. The profits on manufacturing again experienced an increase, but the expenses advanced and the interest on the 4½ per cent. loan of £225,000 had to be paid for the first time. The accounts show the following figures:—

	1907-8.	1906-7.
Share capital paid	£300,000	£300,000
Bonds	225,000	225,000
Profit on manufacturing ...	128,549	108,159
Depreciation provision ...	22,718	19,687
Net profits	25,982	24,311
Dividend, per cent.	6	6

The report mentions that the building extensions had all been brought into operation. The construction of steam turbines in connection with electrical machinery again formed the principal business. It was to be feared that owing to the action of competitors the steam turbine business would in a short time be depressed to an unprofitable price level, but the company were seeking to avert the danger by the cultivation of special branches, as represented by reaction and exhaust steam turbines. The electrical department was also well occupied, although the general decline in prices made itself perceptible through the attempts of competitors to secure orders under any circumstances. The directors expect a profitable extension of business to arise from the introduction of a new kind of variable speed single-phase motor, as well as from a new system which permits of the economical regulation of the speed of large alternating-current motors for work at ironworks and coal mines.

The Continental Company for Electrical Enterprises, of Nuremberg, recently declared for 1907-8 a dividend of 4 per cent. on the preference capital of £1,555,600 out of the total capital of £1,600,000, this rate comparing with 3½ per cent. in 1906-7. According to the directors' report, the company's electricity works and tramways developed satisfactorily during the year, and the receipts showed an upward movement notwithstanding the economic reaction. On the other hand, the receipts did not advance in some places in the same proportion as the higher cost of wages and materials, which specially affected the transport undertakings. The shares held in the Czernowitz electricity works and tramways had been sold at a profit, the Augsburg tramway was to have been taken over by the local authorities according to agreement on September 1st, and the works at Grevenbroich and Sigmaringen also formed the subject of negotiations for transfer to other parties. The net profits realised by the company in 1907-8 reached £70,636, as contrasted with £62,336 in the preceding year. The report gives details of the various undertakings, and among these the suspended railway between Barmen, Elberfeld and Vohwinkel is mentioned as having yielded a surplus of £28,000 in 1907-8, as against £25,600 in the previous twelve months. As total investments, including undertakings owned by the company, the balance-sheet represents a value of £2,598,500, as compared with £2,364,000 in 1906-7, whilst the capital of £1,600,000 is complemented by bonds amounting to £445,500.

Manufacturing in Belgium.

The report of the Ateliers de Constructions Electriques de Charleroi states that the company received orders of the value of £345,000 in 1907, as compared with £276,000 in the previous year. When the company took over the Charleroi works in 1904, a programme was elaborated for completing and equipping them with the most modern machinery, and the work executed in this direction in 1905 and 1906 was also continued last year. The equipment of collieries had largely developed, and numerous customers had been secured. The lighting and power transmission installations had been successfully started at the collieries of Fontaine l'Evêque, Courcelles-Nord, d'Aiseau-Preste and others, together with winding engines on the Ilgner system at two other pits, and orders had been received for various installations at other collieries. Satisfaction was expressed at the expansion in the manufacture of centrifugal pumps for electrical operation on the Rateau system, and the important branch for tramway and railway equipment did not experience any diminution during the year, orders for complete plants having been received both for home and foreign account. The use of electric power for the driving of lifting apparatus was becoming more general, and the company registered orders for 20 cranes for the Port of Antwerp and 15 for Ghent, as well as many orders for travellers and transporters for works and quarries. Various central stations were equipped with turbo-generators, auxiliary machinery and high-tension switchboards, and it is added that the construction of alternators for turbine driving has a tendency to largely extend. The net profits amounted to £27,274, as against £27,800 in 1906, and a dividend of 26s. has been declared on the 9,945 priority shares and 6s. on the 11,055 ordinary shares.

The Compagnie Internationale d'Electricité, of Liége, realised gross profits of £52,200 in 1907-8, and net profits amounting to £33,240; and at the recent general meeting it was decided to devote the whole of the latter sum to the purpose of depreciation with a view to consolidating the company's financial position. According to the directors' report, orders were abundant, and as the cost of production was reduced, the profits were in excess of those obtained in previous years. The order book for the current year was well supplied, and the company would have to carry out, among others, important works for the city of Liége and the port of Antwerp. The work of constructing a new central station in Liége was in progress, and would be finished this year. The activity of the company continued to be directed to certain special applications which appeared still to offer a large market for machines of high powers. The company had equipped nearly all the large rolling mills in the country, and a rolling mill motor of 3,000 H.P., which was the most powerful in Belgium, was about to be started in a metallurgical works; the provision of installations for collieries was also being successfully extended. Apart from these special branches, the company had not neglected the manufacture of ordinary plant—as the transformation proceeding in connection with small industries was resulting in the adoption of a large number of motors. In fact, the establishment of numerous central stations supplying power at moderate charges was opening up a considerable market for electric motors. The ordinary share capital stands at £251,080, and the bonds at £85,600.

The A.E.G.—Union Electrique—of Brussels, which recently decided to increase its share capital from £100,000 to £140,000, experienced a development of business during 1907, and the orders on hand at the beginning of April represented a material advance over those at the corresponding period in 1906. The increased business related both to installations for the metallurgical and coal mining industries, and to undertakings and deliveries for tramways and central stations in Belgium and in other countries. As gross profits, the accounts indicated the sum of £12,542, and the net profits amounted to £11,172. A dividend at the rate of 6·74 per cent. has been declared on the "capital" shares, whilst the amount of £3,224 has been distributed among the "dividend" shares.

Russian Works.

The Russian Allgemeine Electricity Co., whose name indicates its connection with the Berlin company having the same title, states in the report for 1907, that private works and municipal authorities were disposed to place important orders, provided that extended periods for payment could be granted. Although the firms and authorities were thoroughly worthy of credit, the company did not entertain the business in order not to strain its funds. The orders from the Government departments were scarce in consequence of the difficult financial conditions. After meeting working expenses the accounts indicated net profits of £51,147, out of which a dividend at the rate of 4 per cent. has been declared on an ordinary share capital of £600,000.

The Siemens & Halske Co., of St. Petersburg, which reduced its share capital from £700,000 to £560,000 in 1906, is controlled by the parent company in Berlin, and the shares not already held by the latter will soon be acquired by an exchange of shares which will vest the whole undertaking in the hands of the German company. It is stated in the directors' report for 1907 that the orders from private industries contributed towards an increased turnover in consequence of the more favourable course of the economic situation, but Government contracts were extremely restricted. The net profits amounted to £32,629, as contrasted with £279 in 1906, and a dividend of 4 per cent. has been distributed as against nothing in the previous year.

The United Cable Works Co., of St. Petersburg, the formation of which was announced in this journal three or four years ago, will perhaps be recollected as an amalgamation of the cable manufacturing works of the Russian Siemens & Halske Co., the Russian Allgemeine Co. and of the Felten & Guilleaume-Lahmeyer Co. Including the balance brought forward from the preceding year, the gross profits realised by the company in 1907 reached £61,191, and the net profits were £41,510. This sum has allowed of the payment of a dividend at the rate of 5 per cent. as compared with 4 per cent. in 1906.

The Russian Schuckert Co., of St. Petersburg, has an ordinary share capital of £200,000, and maintains branches in Moscow, Kieff, Riga, and Tiflis. During 1907-8 the net profits earned amounted to £9,875, and this sum has permitted of the payment of 3 per cent. dividend, being the same rate as in 1906-7.

The Russian Tudor Accumulator Works Co., of St. Petersburg, in which the Berlin-Hagen Accumulator Works Co. is interested, realised net profits of £17,166 in 1907, on a share capital of £70,000. A dividend of 15 per cent. has been declared, as against 12 per cent. in the preceding 12 months.

NEW PATENTS APPLIED FOR, 1908.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

19,750. "Automatic electric tramway or railway signal." W. H. Taylor. September 21st.

19,757. "Improved construction of regulating switch." Veritys, Ltd., and A. E. Gott. September 21st. (Complete.)

19,778. "Young scouts' telegraph." W. H. Greenaway. September 21st.

19,847. "Process for the prevention of the disintegration into fine dust of electrical incandescent filaments in a vacuum." Gluehlampenwerk Anker G.m.b.H. (Date applied for under Sec. 91 of the Act, October 3rd, 1907, being date of application in Germany.) September 22nd. (Complete.)

19,861. "Improvements in connection with electro-magnets." P. Pinckney. September 22nd.

19,866. "Improvements relating to holders, sockets or like attachment fittings for electric lamps." F. W. Bayliss. September 22nd.

19,871. "Oil switches." J. Burchardt Opsahl. September 22nd. (Complete.)

19,879. "Improved means of working and control for electrically-propelled vehicles." W. A. Stevens. September 22nd.

19,883. "Improvements in the electrical ignition systems of internal combustion engines." J. D. Bell. September 22nd.

19,885. "Improvements in and relating to induction coils and transformer apparatus." H. F. Bigge, F. R. Butt and J. H. Webb. September 22nd.

19,886. "Improvements in and relating to induction coils and transformer apparatus." H. F. Bigge and F. R. Butt. September 22nd.

19,889. "Improvements in and relating to repulsion electric motors." Siemens-Schuckertwerke G.m.b.H. (Date applied for under Sec. 91 of the Act, September 28th, 1907, being date of application in Germany. Application for patent of addition to No. 13,451, 1908.) September 22nd. (Complete.)

19,890. "Improvements in or relating to electrical potential regulators or speed-controlling devices." Siemens Bros. Dynamo Works, Ltd. (Siemens-Schuckertwerke G.m.b.H., Germany. Application for patent of addition to No. 14,725, 1907.) September 22nd. (Complete.)

19,891. "Improvements in and relating to cooling the commutator of a dynamo-electric machine." Siemens Bros. Dynamo Works, Ltd., and E. O. Kiefer. September 22nd. (Complete.)

19,921. "Improvements in and relating to the regulation of dynamo-electrical machinery and the like." Aktiengesellschaft Brown, Boveri & Cie. (Date applied for under Sec. 91 of the Act, February 3rd, 1908, being date of application in Germany.) September 22nd. (Complete.)

19,932. "Manufacture of filaments for electric incandescence lamps from tungsten or alloys thereof." Siemens & Halske Akt.-Ges. (Date applied for under Sec. 91 of the Act, September 26th, 1907, being date of application in Germany.) September 22nd. (Complete.)

19,946. "Adjustable spindle carrier for commutator grinding gear." A. J. Salisbury. September 23rd. (Complete.)

19,972. "Improvement in the method of regulating continuous-current motors." F. J. Culligan. September 23rd.

19,974. "Improvements in electrodes of secondary batteries." J. Taylor and E. Hancock. September 23rd.

19,992. "Improvements in and relating to the regulation of dynamo-electric machinery and the like." Aktiengesellschaft Brown, Boveri & Cie. (Date applied for under Sec. 91 of the Act, August 24th 1908, being date of application in Germany.) September 23rd. (Complete.)

20,005. "Improvements in electric signalling." R. A. Fessenden. (Date applied for under Sec. 91 of the Act, October 31st, 1907, being date of application in United States.) September 23rd. (Complete.)

20,011. "Improvements in recording compasses." E. Schuette and N. Dedrick. (Date applied for under Sec. 91 of the Act, July 3rd, 1908, being date of application in United States.) September 23rd. (Complete.)

20,058. "Improvements relating to electric conductors or cables." W. E. Hitch. September 24th.

20,085. "Electric incandescent light unit." J. K. Heydon. September 24th.

20,098. "Improvements in dynamo-electric machines." A. Boeckel, O. Grunberg, J. Korwin-Krukowski. September 24th.

20,158. "Improvements in electric arc lamps." F. Proctor. September 25th.

20,179. "Electro-pneumatic device chiefly intended to indicate attempts to tamper with articles to be protected." E. Seragnoli. September 25th. (Complete.)

20,189. "Improvements in and relating to continuous-current dynamos." L. A. Notcutt and O. Notcutt. September 25th.

20,206. "Improvements in and relating to wireless communication." L. de Forest. September 25th. (Complete.)

20,210. "Improved means of converting existing petrol omnibus chassis into electric or petrol-electric vehicles." W. A. Stevens. September 25th.

20,226. "Improvements in electric ignition systems of internal combustion engines." J. D. Bell. (Application for Patent of Addition to No. 19,883/08.) September 26th.

20,250. "New or improved electrical controlling apparatus." F. H. Edwards. September 26th.

20,266. "Improvements in portable electric lamps especially adapted for use in mines." The New Ignition Syndicate, Ltd., F. J. Rouse and W. J. L. Sandy. September 26th. (Complete.)

20,268. "Improvements in or relating to overload circuit-breakers." Siemens Bros. Dynamo Works, Ltd. (Schuckertwerke G.m.b.H., Germany.) September 26th. (Complete.)

20,288. "Improved terminal for magneto-electric ignition apparatus." F. R. Bosch. (Date applied for under Sec. 91 of the Act, November 15th, 1907, being date of application in Germany.) September 26th. (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1907.

Printing Telegraph Receivers. J. Burry. 12,342. May 29th.

Electrical Propulsion of Marine Vessels. H. A. Mavor, Mavor & Coulson, Ltd., and J. H. Biles. 12,386. May 28th.

Alternating-Current Electric Motors of the Repulsion Type. British Thomson-Houston Co. (General Electric Co., United States.) 12,073. June 5th.

Alternating-Current Motors of the Commutator Type and Methods of Operating the Same. British Thomson-Houston Co. (General Electric Co., United States.) 17,474. July 30th.

Apparatus for Strengthening Weak Current Impulses, Alternating Currents and Variations in Current Strengths, Applicable to Telegraphy and Telephony. A. Pollak. 19,282. August 27th.

Electricity Control Relays. C. C. Garrard and Ferranti, Ltd. 19,570. August 31st.

Metallic Filaments or the like for Electric Glow Lamps and the Method of Making Same. Ges. für Verwertung Chemischer Produkte. 19,672. September 3rd. (Date applied for under International Convention, August 2nd, 1907.)

Signalling and like Systems. Allgemeine Elektricitäts Ges. 19,699. September 3rd. (Date applied for under International Convention, September 3rd, 1906.)

Protective Devices for Alternating Electric Current Distribution Systems. British Thomson-Houston Co., R. C. Clinker, E. B. Wedmore and J. E. Woodbridge. 19,883. September 5th.

Manufacture of Refractory Bodies. British Thomson-Houston Co. (General Electric Co., United States.) 20,227. September 10th.

Supporting or Carrying of Dynamo-Electric Machines. H. C. C. C. Silver. 22,285a. October 9th. (Date applied for under Rule 18, October 9th, 1907.)

Balancing the Lines of Electric Circuits, Particularly those Employed in Duplex Systems of Telegraphy. P. M. Justice. (The Rowland Telegraphic Co., United States.) 22,728. October 15th.

Electro-Mechanical Means for Controlling Belt Gearing. W. E. Clark. 23,311. October 22nd.

Electrical Indicators for Indicating Water and other Liquid Levels. W. E. Lake. (The Auto Pump Co., United States.) 24,103. October 31st.

Electric Cooking Apparatus. British Thomson-Houston Co. (General Electric Co., United States.) 25,752. November 20th.

Insulated Electric Conductors and Process of Forming the Same. British Thomson-Houston Co., Ltd. (General Electric Co., United States.) 25,922. November 22nd.

Electric Time Switches. G. Lüthi. 27,986. December 19th.

Relays for the Protection of Electric Circuits. K. Edgcumbe and E. T. Everett. 20,095. September 9th.

Arrangements for Equalising and Compensating the Loads on the Phases of Polyphase Current Systems. Siemens Bros. Dynamo Works, Ltd. (Siemens Schuckertwerke Ges.) 20,203. September 10th.

Controllers and Starting Switches for Electric Motors. Veritys, Ltd., and A. E. Gott. 20,332. September 12th.

Multiple Trembler Induction Coil Ignition Systems. S. J. Watson and G. H. Smith. 20,348. September 12th.

Means for Effecting the Ignition and Combustion of Liquid Fuel in Internal-Combustion Engines. P. Reilly. 20,396. September 12th.

Electrical Transmission of Power for Propelling Vehicles of all Kinds. R. Werkner. 20,785. September 18th.

Motor-Driven Clocks, Electrically Controlled. I. H. Parsons and A. E. J. Ball. 20,878. September 20th.

Magneto Machines Chiefly for the Ignition of Internal-Combustion Engines. J. D. Bell. 20,986. September 21st.

Starting Devices for Electric Motors. British Thomson-Houston Co. (Allgemeine Elektricitäts Ges., Germany.) 22,870. October 16th.

Means in Connection with Electric Circuits for Altering the Difference of Potential of Two Points of a Circuit between which a Practically Constant Current has to Flow. Felten & Guilleaume Lahmeyerwerke Akt.-Ges. 23,216. October 21st. (Date applied for under International Convention, October 19th, 1906.)

Ignition Devices for Internal-Combustion Engines. F. J. Luke. 23,290. October 22nd. (Post-dated March 30th, 1908.)

Control of Alternating Electric Current Motors. British Thomson-Houston Co. (General Electric Co., United States.) 23,707. October 26th.

Arc Lamps. W. A. Legge and F. A. Scott. 24,635. November 7th. (Post-dated April 3rd, 1908.)

Controlling Mechanism for Electric Motor-Operated Signals for Railways and the like. British Thomson-Houston Co. (General Electric Co., United States.) 24,993. November 11th.

Electrically-Operated Signalling Installations. De Courcy Beamish. 25,740. November 20th.

Insulating the Windings of Dynamo-Electric Machines. British Thomson-Houston Co. and F. H. Clough. 25,834. November 21st.

Electro-Motors. Aarhus Dynamo & Elektromotor-Fabrik and S. P. Johansen. 25,999. November 23rd.

Devices for Threading Electric Conduits. A. H. de Voe. 26,489. November 30th.

Portable Electric Egg-Testing Lamp. H. Langham. 26,661. December 3rd.

Electrical Signalling System for Railways. H. L. Rider. 26,938. December 5th.

Electric Arc Lamps. H. Bevis and A. E. Angold. 27,412a. December 12th. (Date applied for under Rule 13, December 12th, 1907.)

1908.

Receivers for Wireless Telegraphy. R. A. Fessenden. 2,685. February 6th. (Date applied for under International Convention, February 8th, 1907.)

Electrical Operation or Control of Railway Points. W. R. Sykes. 4,368. February 25th.

Apparatus for Electrolytically Etching or Depositing Metals upon Metallic Surfaces and the like. S. O. Cowper-Coles. 5,317. March 9th.

Portable Electric Resistance for Use with Surgical or Medical Lamps. F. N. Davidson. 5,374. March 10th.

Automatic Electric Switching Devices. A. J. Boult. (Voigt & Haeffner Akt.-Ges., Germany.) 8,286. April 14th.

Electrically-Operated Heating Devices. Fried Krupp Akt.-Ges. Germaniawerft. 9,449. May 1st. (Date applied for under International Convention, June 24th, 1907.)

Pocket Electric Lamp. P. M. E. Bourgeois and C. H. Bourgeois. 12,680. June 12th.

Manufacture of Filaments for Electric Glow Lamps from Refractory Materials in the Colloidal State. H. Kuzel. 12,968. June 17th. (Patent of Addition to No. 28,154 of 1904.)

Antiseptic Attachment for Telephone Mouthpieces. J. Freel. 14,805. July 13th.

Telephones. N. D. Phillips. 16. January 1st.

Electric Lamp Cluster Holders. W. Fairweather. (Benjamin Electric Manufacturing Co., United States.) 620. January 10th.

Electric Type-Printing Telegraphic Apparatus. G. A. M. Agrell. 700. January 11th. (Rights under Sec. 91, Patents, &c., Act, 1907, not granted.)

Insulating Electric Wires, Cables and the like. J. E. Glenister and G. W. Glenister. 811. January 13th.

Arrangements for Preventing the Loss of Electric Energy by Heat when Working Projectors and the like. A. Lertourne. 1,754. January 25th. (Date applied for under International Convention, February 11th, 1907.)

Generation of Electricity on Railway Trains, Boats or the like. J. H. Sveinbjornsson. 4,364. February 26th.

Process of and Means for Manufacturing Filaments for Illuminating and Heating Purposes. G. Michaud and E. Delasson. 4,461. February 27th. (Date applied for under International Convention, June 10th, 1907.)

Guides for Pulleys or Trolley Heads in Connection with the Electric Wires for Tramcars and the like. T. Pidd. 4,509. February 28th.

Primary Batteries. W. A. F. Bleeck. 5,297. March 9th.